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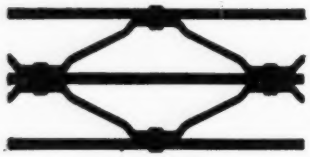

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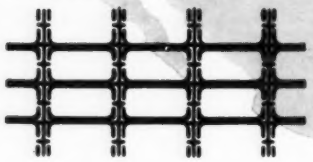

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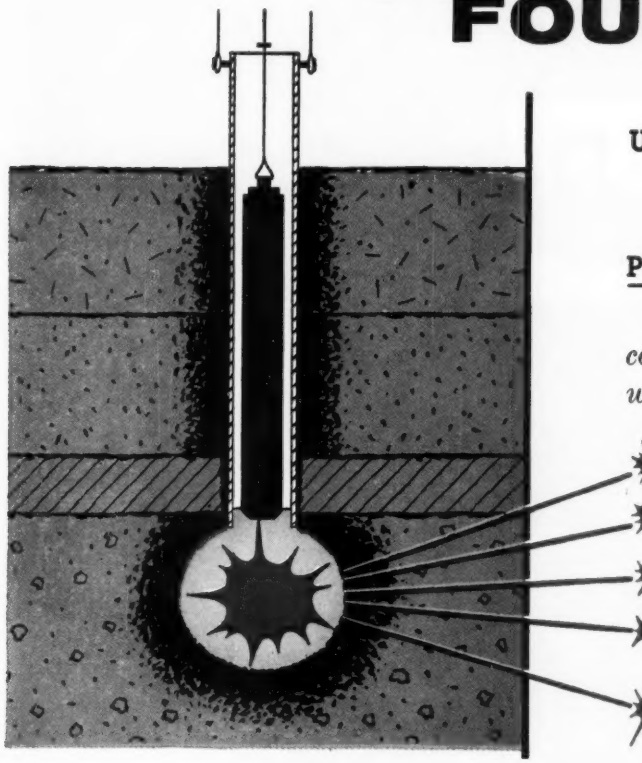

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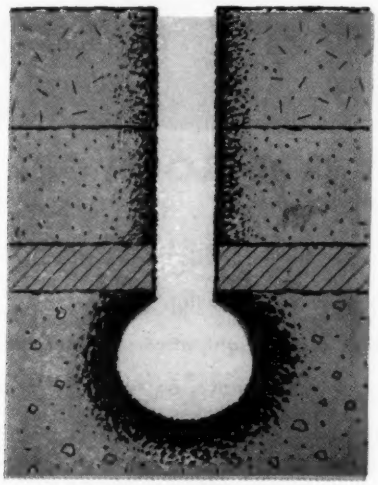

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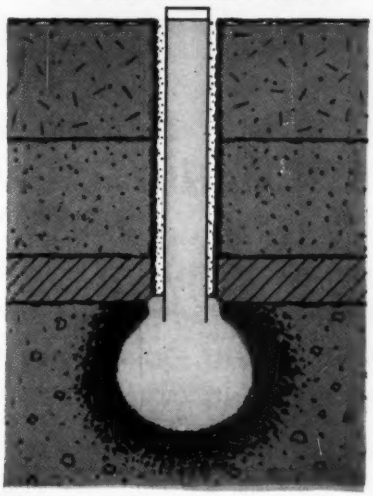

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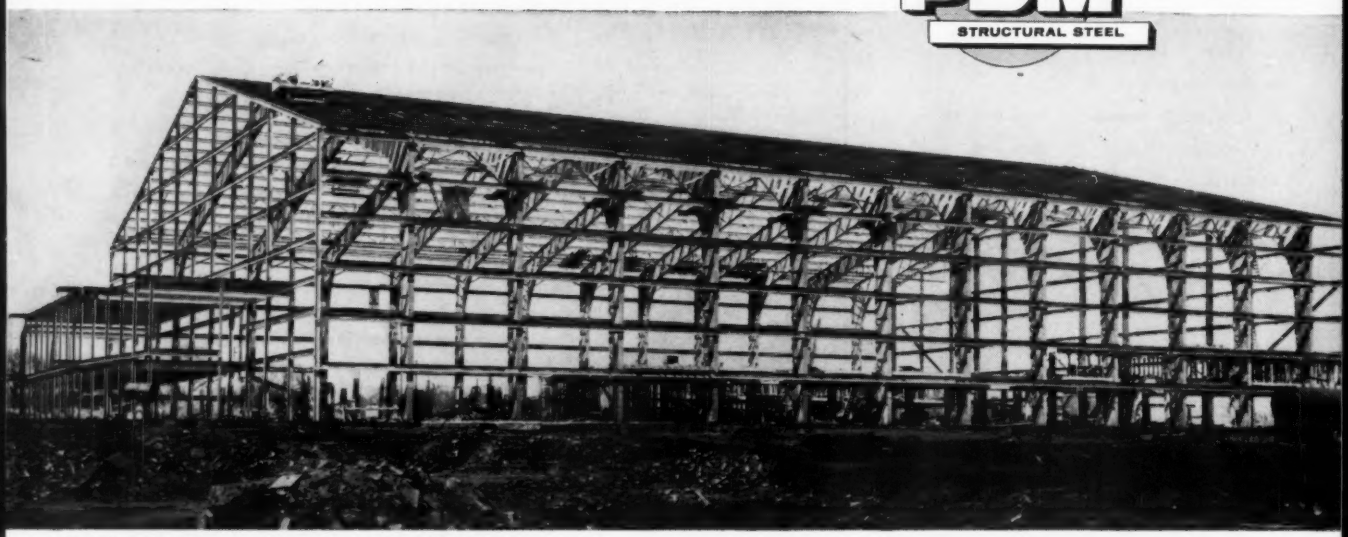

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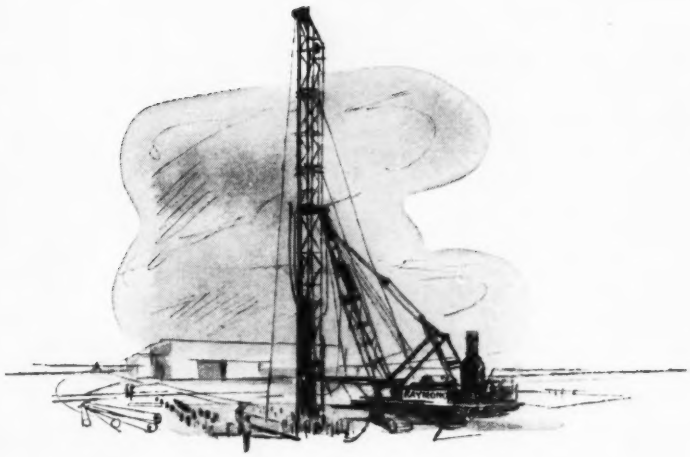

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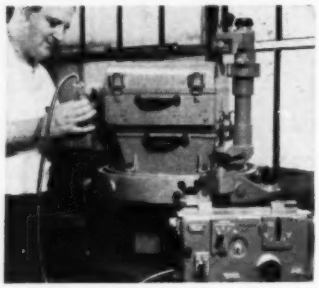

$15,000 Wild mapping camera, bench-checked before survey begins, brings new clarity, detail, precision to air photos.

New Engineering "Chain" Proves Accurate Up to 1 Part in 300,000

Newest mapping tool used by AERO field crews is the *Tellurometer*. Developed in South Africa, this radar device functions as a new engineering "chain." It makes precise measurements over distances from one-half mile to 30 miles or more. For example, AERO tests show 1:80,000 accuracy for a 27,414 ft. distance and 1:300,000 for a 42,327 ft. distance. And the *Tellurometer* works in daylight or dark, rain or fog, in spite of intervening trees.

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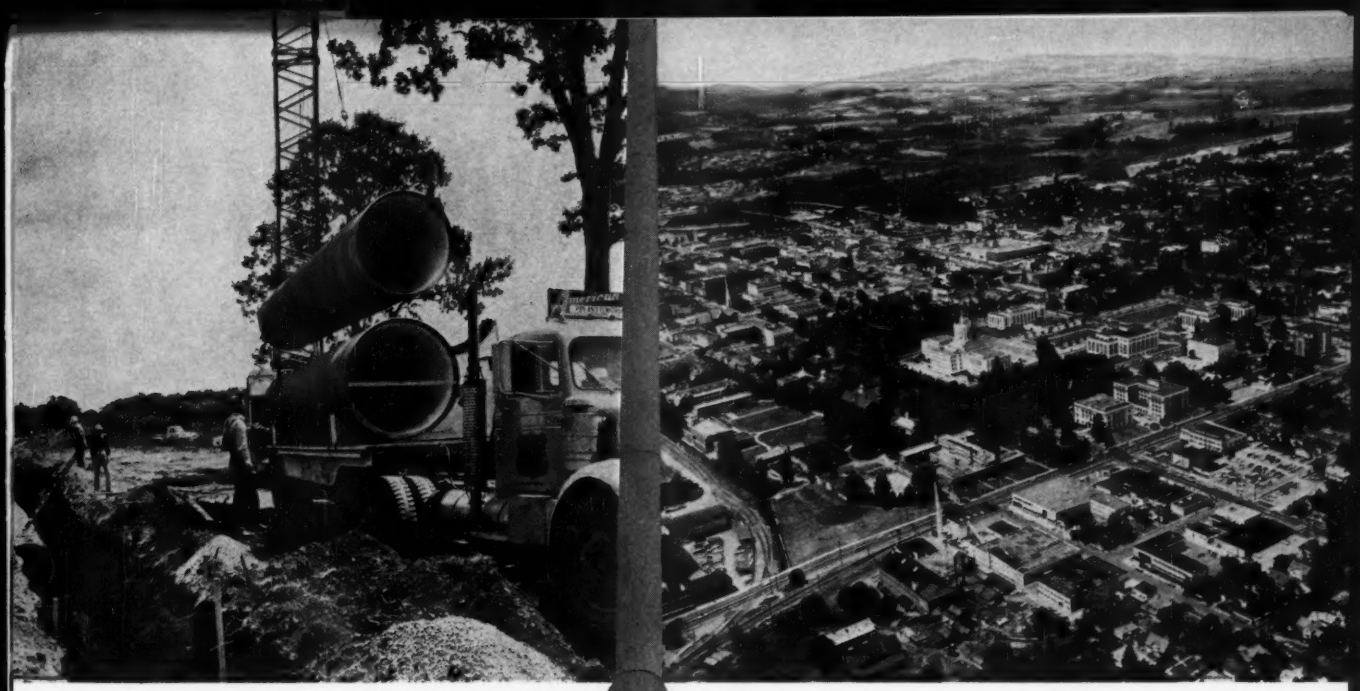


New Salem pipe line to augment present system will add approximately 50 MGD capacity to city water supply system.

a line of growth... for Oregon's capital city

American Concrete Cylinder Pipe is helping Salem, Oregon to grow

A simple but important fact is that no city, however great its potential, can grow beyond the capacity and dependability of its main water supply system.

Recognizing this fact, and envisioning a population in 30 years that will require three times the maximum capacity of present water transmission lines, Salem, the capital city of Oregon, is carrying out a program designed to meet future needs.

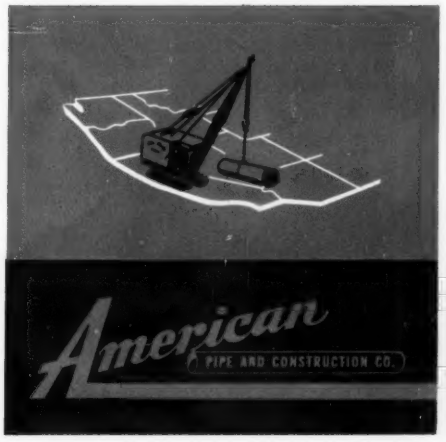
Under the direction of the City's Water Department Manager, John L. Geren, and the technical supervision of Consulting Engineers Clark and Groff of Salem, an 18-mile pipe line of 48″ and 54″ diameter American Concrete Cylinder Pipe is being installed by Lord Brothers, a general contracting firm of Portland, Oregon. This new line will triple the present capacity of the supply system.

The performance record of this type of reinforced concrete cylinder pipe has been so outstanding throughout the West that Salem can be confident that this water "growth line" will be giving efficient, economical service for many, many years to come.

Strength, permanence, sustained high carrying capacity, and trouble-free service are characteristics of American Concrete Cylinder Pipe which make it the right pipe for this forward looking city.

When planning your future water "growth lines," look to American's quality pipe line products, extensive production facilities and half century of experience.

Ask for complete information concerning the particular class of pipe that will meet your design requirements.



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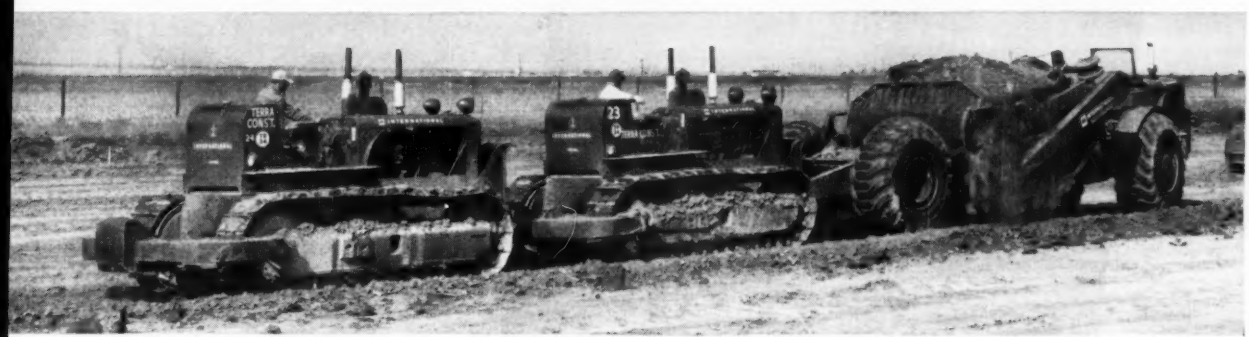

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Terra gets an 11.3% production advantage with profit-wise TD-24 tandem push-loading.

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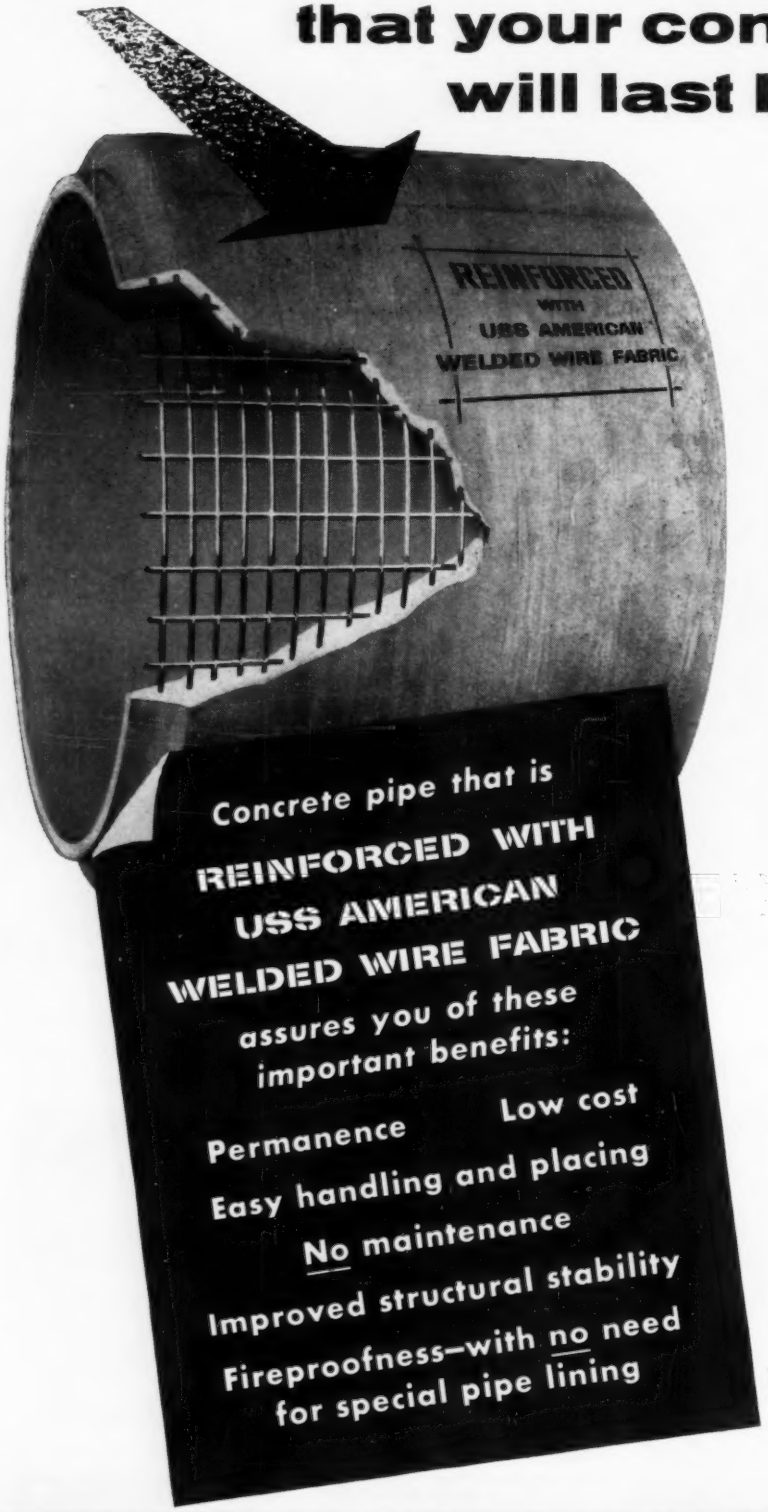

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For the Best Reinforcement be sure it is USS American Welded Wire Fabric. This reinforcement is precision-manufactured from quality cold-drawn steel wires. Its quality is rigidly controlled to assure you a fabric that meets every specification—exactly—shipment after shipment.

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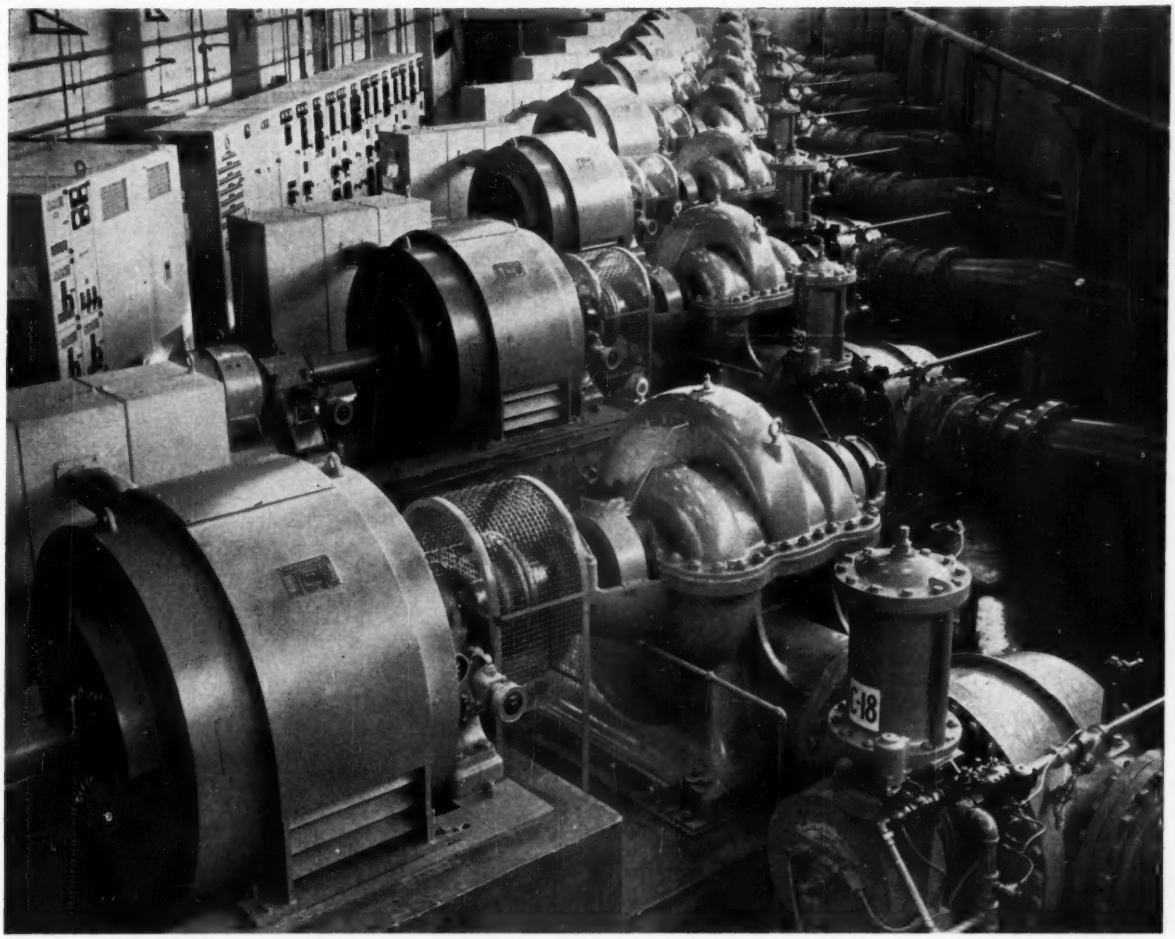

Eight 24" SMS-Rotovalves are used for pump check service at the Secondary Pumping Station of the U. S. Air Force's Arnold Engineering Development Center in Tullahoma, Tenn.* Installed on 25,000 GPM pumping units, each hydraulically-operated Rotovalve has independent timing control for opening and closing, and a by-pass fast closure device for shut down in the event of power failure. Four more 24" Rotovalves perform similar service at the Primary Pumping Station.

CLOSE CONTROL OF TIMING MAKES SMS-ROTOVALVES CHOICE AT TULLAHOMA

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SMS-Rotovalves' full-line opening offers no more resistance than straight pipe of the same diameter, means less head loss and lower pumping costs. Maximum initial shut-off, with retarded area reduction at the closing end of the stroke, controls water hammer. Opening and closing can be as fast as one second, or as slow as needed. Closure is drop tight, and monel-to-monel seats are self-purging.

You can obtain full information on SMS-Rotovalves, Ball Valves or Butterfly Valves by contacting our nearest representative. Or, write to S. Morgan Smith Co., York, Penna.

*Under construction by the Corps of Engineers, U. S. Army.

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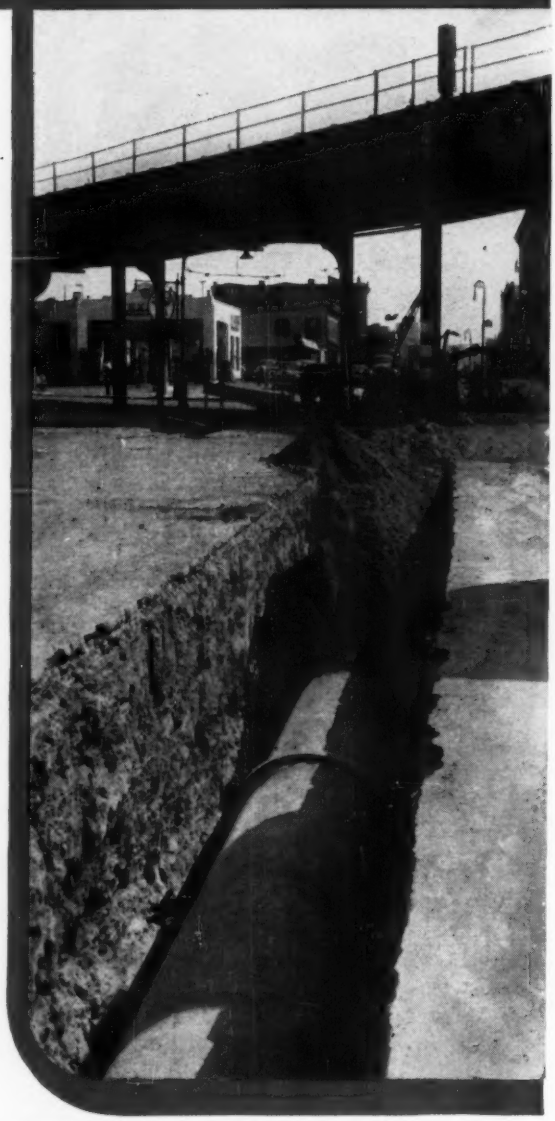

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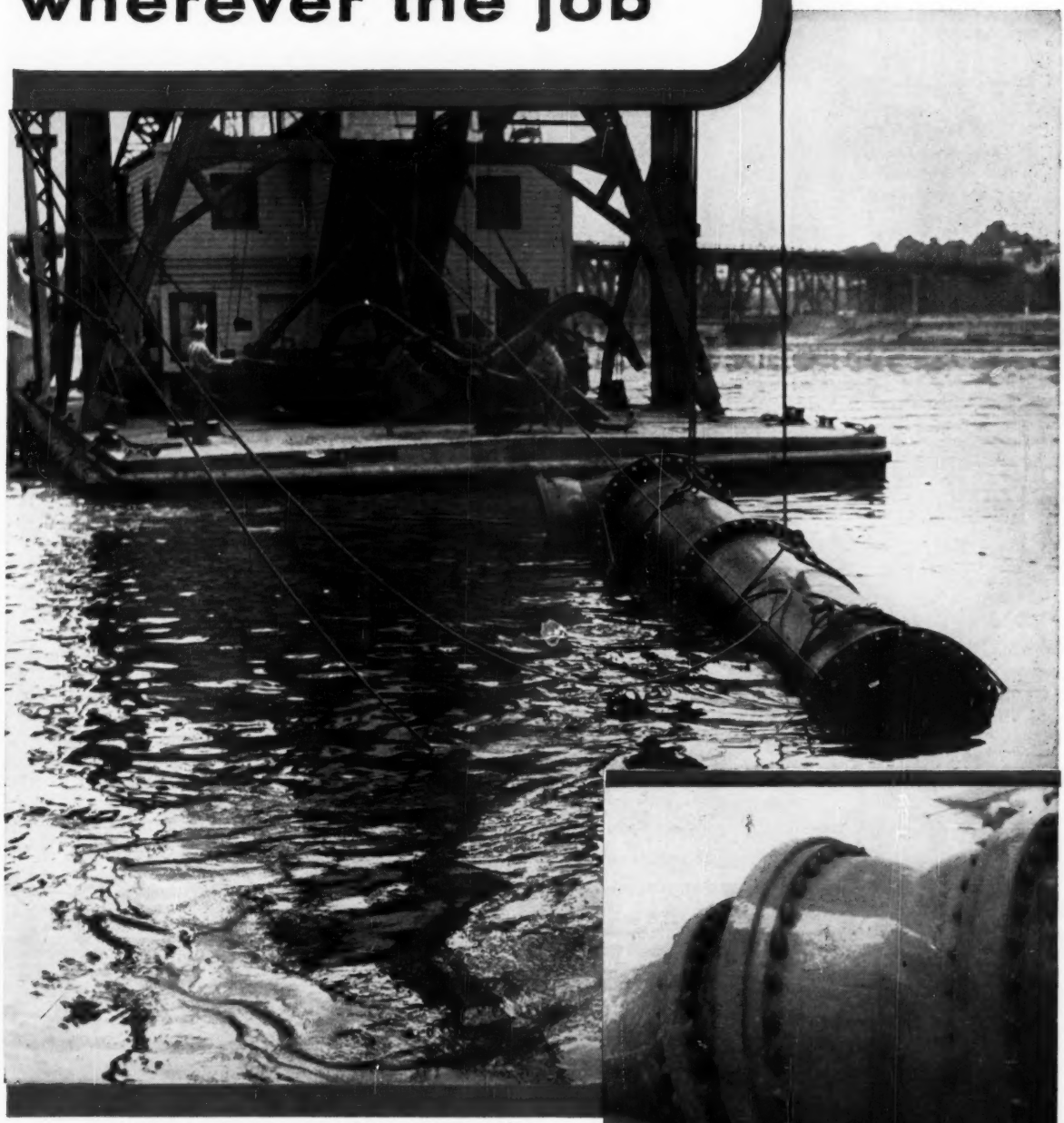

Portland, Ore.—Large diameter cast iron sewer lines being installed across Willamette River, part of program to restore normal river conditions for salmon spawning.

St. Louis County, Mo.—36" cast iron intake line at the North County Water Plant of the St. Louis County Water Company.

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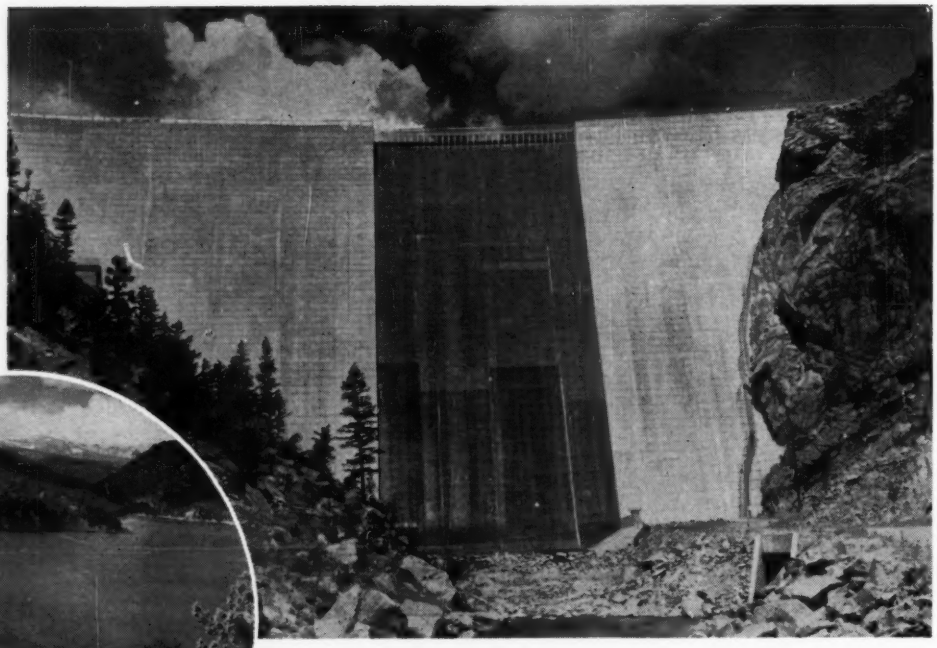

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Expandable Gross Dam Stores Denver Water

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625,000 cubic yards of concrete were used in the present dam structure. For the future, the dam can be enlarged by increasing its height 120 feet to 460 feet, and its thickness. To do this, the present reservoir need not be de-watered, as the thickening and raising of the dam would be accomplished on the outside face. Total capacity of the enlarged dam would nearly triple present reservoir storage to 113,000 acre-feet of water.

Today's dam answers today's needs for water. Tomorrow's expanded structure is an excellent demonstration of the versatility of concrete in solving a difficult construction problem. Gross Dam is built 100% of Ideal Cement concrete.

PORTLAND IDEAL CEMENT

IDEAL CEMENT COMPANY

DENVER, COLORADO

14 Plants and 2 Terminals Serving
Some of the Most Rapidly Growing Areas of the Nation

for live power,
strength scaled to BIG JOBS,
matchless service ease . . .

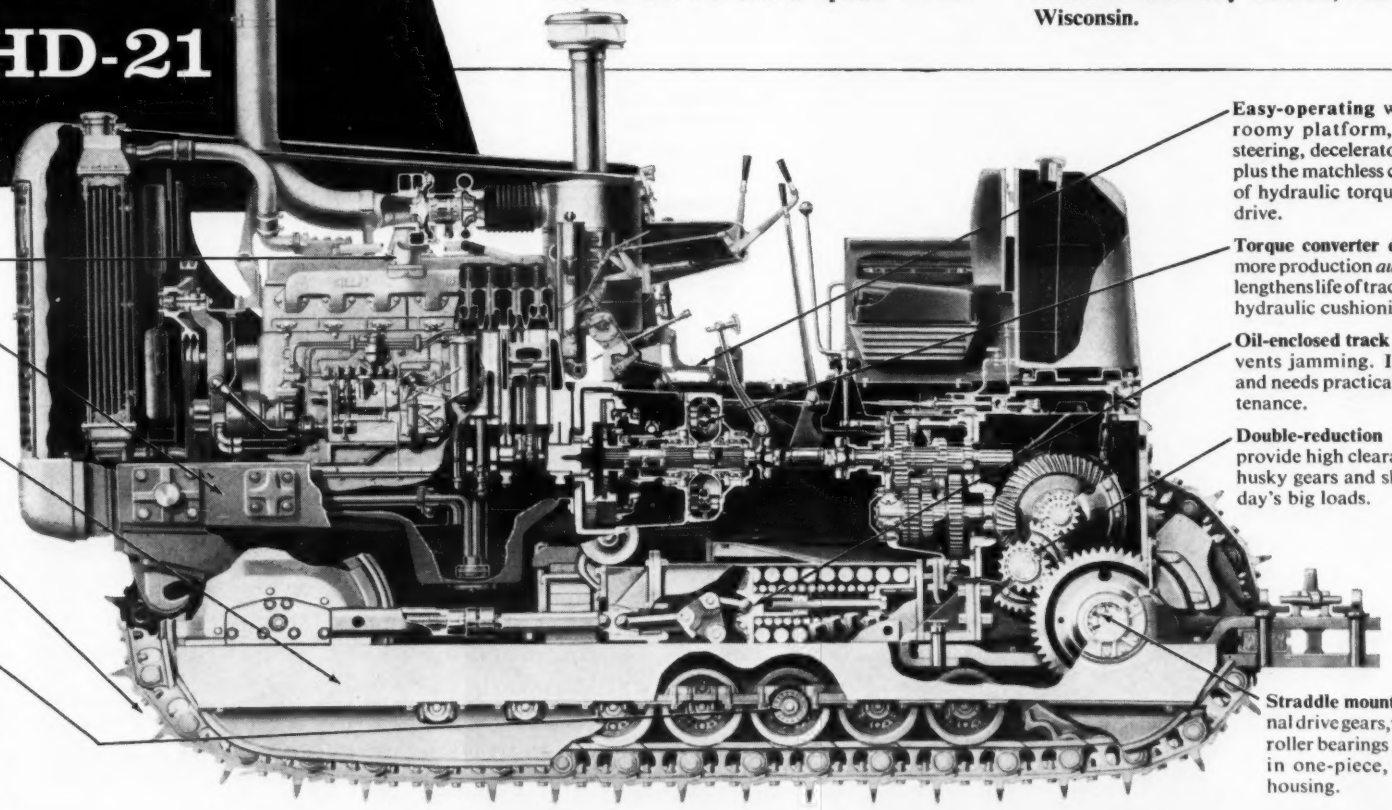
you owe yourself
a close-up look at the

NEW HD-21

This is live power! Allis-Chalmers' new turbo-engine delivers 225 net usable horsepower. Hydraulic torque converter drive puts this power to work—automatically provides the right pull or push for every load, at the maximum travel speed for existing conditions. New, longer track provides outstanding traction, flotation and balance.

Ask the men who own or operate the new high-production HD-21. On jobs that really put a tractor to the test, they all like the responsive way it handles, the way it moves into the dirt fast and keeps moving in toughest going.

The Allis-Chalmers HD-21 offers you more working tractor ability—dollar for dollar—than any other big crawler tractor you can buy. Just compare and you'll agree! Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.



New turbo-engine brings extra power, cleaner operation, new fuel economy and longer life.

Unit construction with Box-A Main Frame design lets you remove major components without disturbing adjacent assemblies.

Cost-cutting alignment—special high-strength steel truck frames keep tracks, idlers, rollers and sprockets riding true for longer life.

Tough track—true-dimension machining and heat treating insure outstanding wearability under severe job conditions.

Easy-rolling, easily maintained truck wheels—with Positive Seals and tapered roller bearings, the HD-21's truck wheels, idlers and support rollers ride freely to deliver more usable horsepower . . . need greasing only once every 1,000 hours.

Easy-operating with clean, roomy platform, hydraulic steering, decelerator pedal . . . plus the matchless convenience of hydraulic torque converter drive.

Torque converter drive means more production *automatically*, lengthens life of tractor through hydraulic cushioning.

Oil-enclosed track release prevents jamming. It's reliable and needs practically no maintenance.

Double-reduction final drives provide high clearance, permit husky gears and shafts for today's big loads.

Straddle mounting of all final drive gears, with tapered roller bearings . . . mounted in one-piece, line-bored housing.

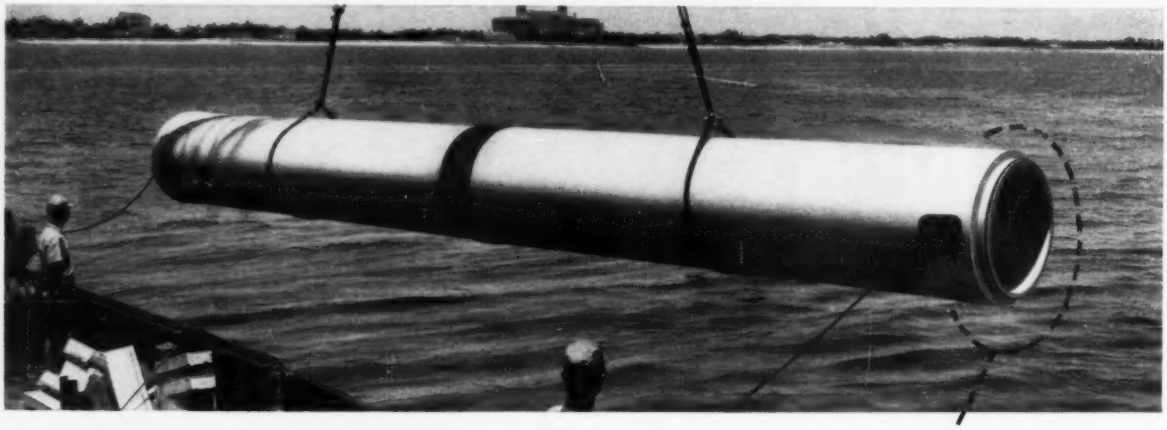
Your Allis-Chalmers dealer will be glad to demonstrate the 21's live-power performance . . . and to prove it can help you on your big jobs.

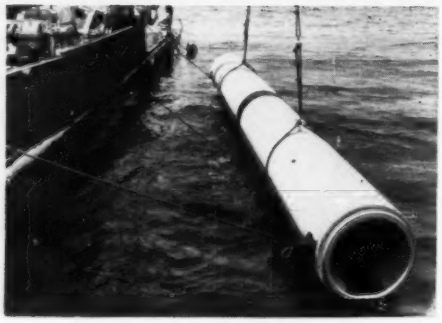
ALLIS-CHALMERS

Engineering in Action

LONG

LENGTH CONCRETE PIPE





Subaqueous ocean outfall line at Palm Beach, Florida. Engineer: Norman C. Schmid & Assoc., Palm Beach. Contractor: Powell Bros. Co. Inc., Ft. Lauderdale.

with **TIGHT** STEEL and RUBBER **AMSEAL JOINTS**

Whether you want to keep water in or out—or both—American-Marietta long length concrete pipe with Amseal joints will do it better at less cost. In fact, the Engineer on the above job says, "The original design called for 24″ diameter pipe of another type but 30″ Amseal Subaqueous Pipe proved more economical."

The longer lengths enable a contractor to install 32 feet of pipe—often 64 feet—at a time. This means less handling and joint making . . . improved flow capacity through use of fewer joints.

The "pressure proven" rubber and steel Amseal joint provides a flexible but positive water-tight seal against costly infiltration or leakage. For underwater work subaqueous connections are provided to simplify installation. Write our technical staff for assistance with your pipe problems.

Another example of
PROGRESS IN CONCRETE

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CONCRETE PRODUCTS DIVISION
GENERAL OFFICES:
AMERICAN-MARIETTA BUILDING
101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS, PHONE: WHITEHALL 4-5600

WHAT BUT A BELT CONVEYOR could carry this load for so few pennies a ton?
Moving at high speed—24 hours a day if required—belt conveyors handle huge tonnages in a continuous stream. Loading and unloading delays are eliminated, and there's no time lost on empty return runs. Operating costs are relatively low, based on cost per ton handled. In fact, economies of belt conveyor operation and upkeep generally top any other form of bulk material transportation. And thanks to their extreme flexibility, installation is easy even in difficult locations.

WHO BUT LINK-BELT offers such a complete belt conveyor service? For any requirement—new installation or modernization job—Link-Belt will plan it, equip it, erect it and stand behind it. Our engineers can choose from industry's most comprehensive idler line—plus a broad range of pulleys, drives, terminal machinery and auxiliary equipment. Because all drawings and equipment come from one source, responsibility is centralized . . . no need to waste valuable engineering man-hours coordinating drawings from several sources.

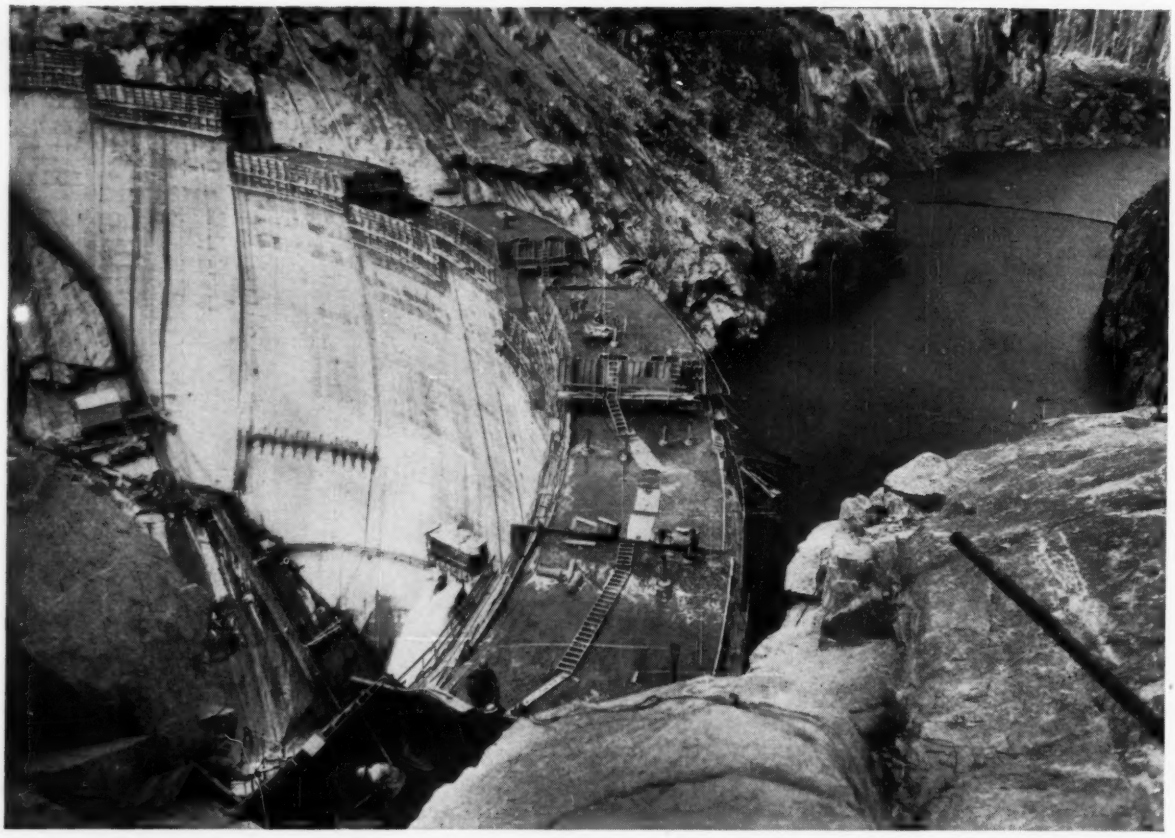
OVERALL ENGINEERING | COMPLETE EQUIPMENT | SKILLED ERECTION | ASSURED SATISFACTORY PERFORMANCE

Add to the basic economies of belt conveyors the extra advantages offered by Link-Belt—it's a formula producing lower costs per ton for all industry. Your nearby Link-Belt office can furnish complete information. 14,621

LINK-BELT

BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs.



DONNELLS DAM, located 40 miles above Sonora, California, rises 484 ft. from its granite bedrock foundation. Blaw-Knox Steel Forms were used extensively in forming the 317 ft. high concrete arch which tapers in thickness from 41 ft. at its base to 10 ft. at its crest.

Special Blaw-Knox Forms shaped for Arch Dam Contours

. . . can be re-used again on flat surfaces

Blaw-Knox forms engineers designed a special jack screw to curve, twist and warp steel forms to fit both the concave and convex contours of Donnells Arch Dam in California. And, these same forms can be re-used again for flat surface forming.

Other special features allowed the same set of forms to be used over and over again on all parts of the dam. This meant big savings in on-the-job construction and engineering costs. Setting and stripping of the forms was made faster on the adjusting screw system.

Donnells is part of the huge Tri-Dam project which will supply water and electric power to a large part of Northern California. The project is a joint effort of Tri-Dam Constructors headed by Morrison-Knudsen Company, Inc., and includes Macco Corporation, Peter Kiewit Sons' Company and Stolte, Incorporated.

If you are engaged in heavy concrete construction, such as Dams, Tunnels or Bridges, call in the Blaw-Knox Forms Engineers early in your planning. You will get the benefit of their unmatched experience in this field to help you form faster, cut labor and material costs.

BLAW-KNOX

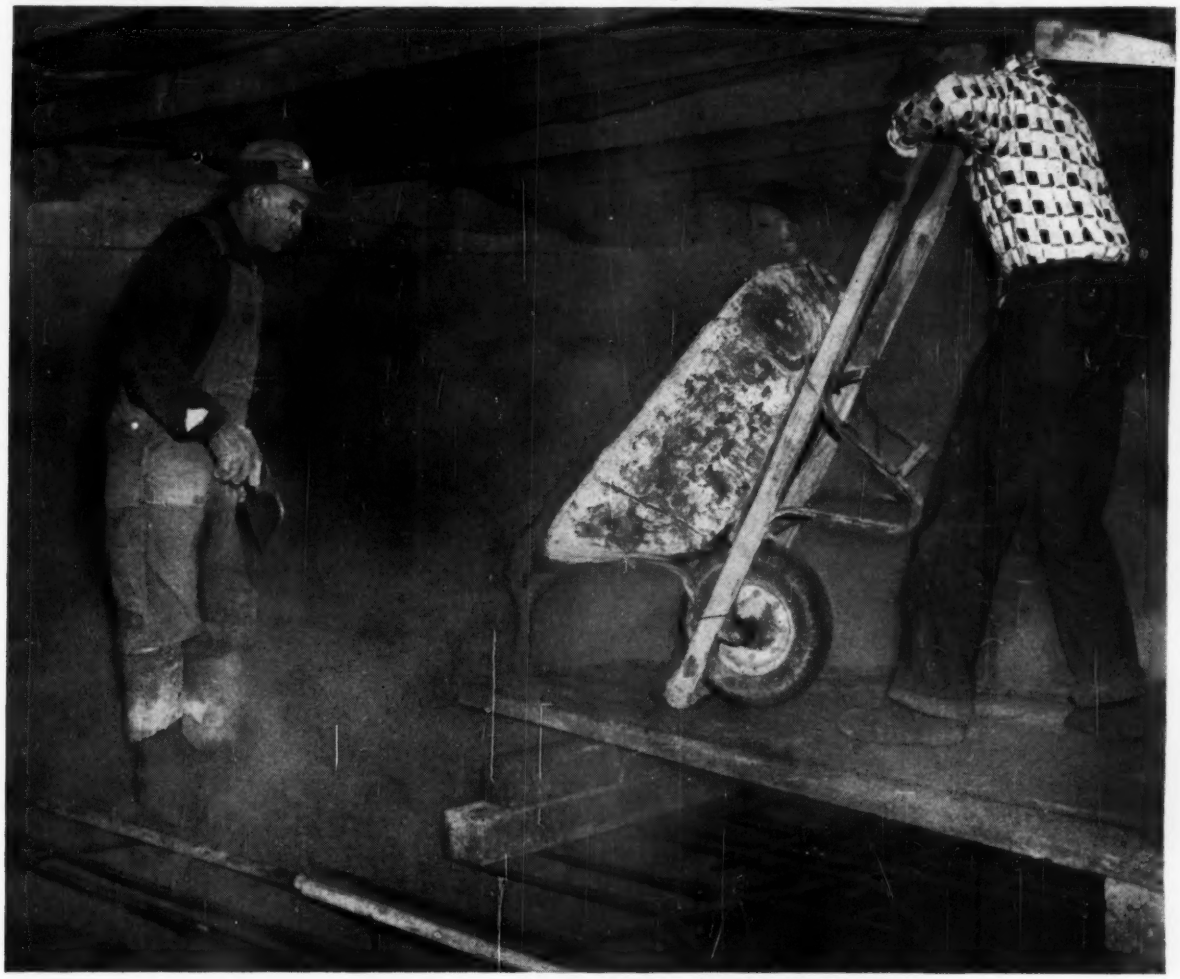
BLAW-KNOX COMPANY

Blaw-Knox Equipment Division

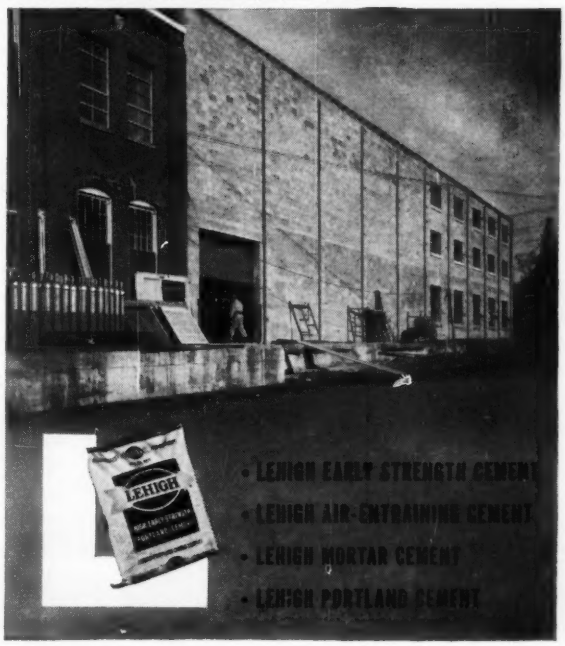
Steel Forms Department, Pittsburgh 38, Pa. • Phone: STerling 1-2700

Placing 9″ thick concrete second floor for this low-cost, fireproof, Wisconsin dairy warehouse.

Bottom photo.: Concrete block walls for this 140′ x 90′ building were laid up with Lehigh Mortar Cement.



Owner: Sanna Dairies Inc., Menomonie, Wisconsin
Contractor: Stahr Company Inc., Minneapolis, Minnesota



LEHIGH EARLY STRENGTH CEMENT cuts **mid-winter** construction costs

This new warehouse was being built in Menomonie, Wisconsin just a year ago. Temperatures dropped to 15° below zero. To keep mid-winter construction costs down and have the job ready for the owner by early spring, Stahr Company Inc. used Lehigh Early Strength Cement.

The quick-curing concrete made with Lehigh Early Strength Cement enabled the contractor to cut form rental costs 30% and to reduce winter protection costs 50%. What's more, with less bleeding and earlier hardening of the early strength concrete, finishers' overtime was cut 50%.

Remember Lehigh Early Strength Cement when planning winter concrete work. On large jobs and small, chances are it will save *you* time and money.

LEHIGH PORTLAND CEMENT COMPANY
ALLENTOWN, PA.

why work like

No need to when you lay Tyton Joint® pipe. This quick and easy-to-assemble pipe goes in so smoothly it's a pleasure to work with.

Only one accessory needed—a simple rubber gasket that fits in the receiving pipe bell and is compressed by the entering spigot to permanently seal the joint. No bell holes. No weather worries. Tyton Joint can be laid in rain or wet trench.

A word of warning, however: make sure your trenching machine gets an early start or

U.S. cast iron PIPE FOR WATER, SEWERAGE AND

a dog?

your laying crew—even an inexperienced one—will catch up fast.

Like all the facts on this new, time-and-money-saving pipe? Call or write today.

U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

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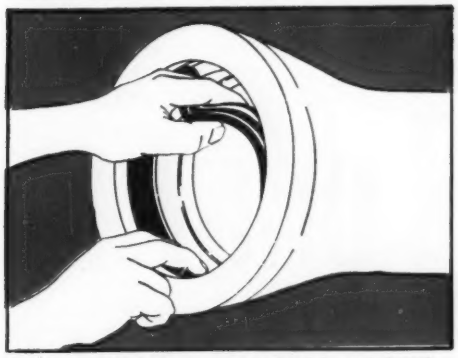
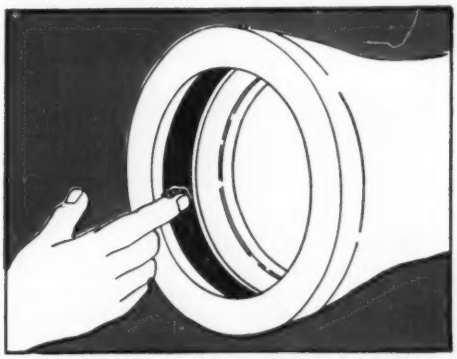
INDUSTRIAL SERVICE CAST IRON

U. S. **TYTON** JOINT

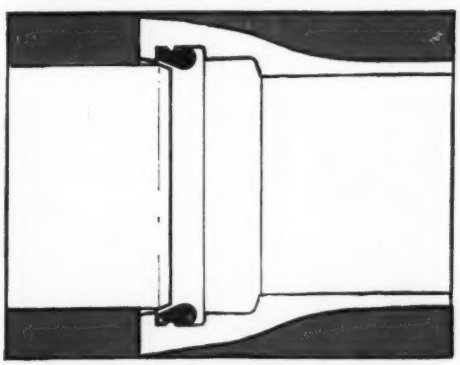
ONLY FOUR SIMPLE ACTIONS



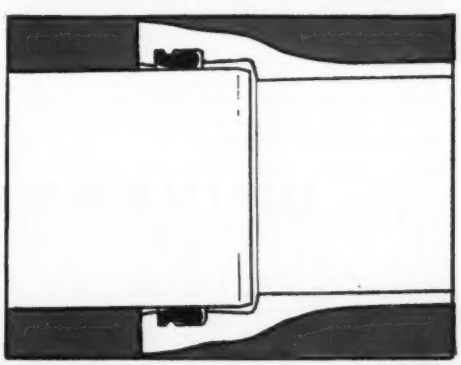
Insert gasket with groove over bead in gasket seat



Wipe a film of special lubricant over inside of gasket



Insert plain end of pipe until it contacts gasket



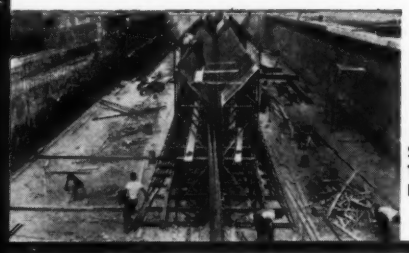
Force plain end to bottom of socket . . . the job's done!

reduce forming costs...

with

UNI-FORM

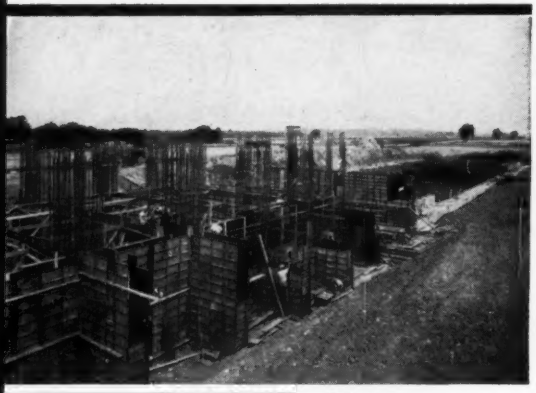
PANELS



Sewage Treatment Plant "Y" Walls

Slabs

Circular Walls



Heavy Industrial Foundations

Whether you're bidding on a sewage treatment plant, industrial building, highway bridges, overpasses or abutments, heavy foundations, circular tanks or a warehouse, UNI-FORM Panels will give you the lowest all around forming costs.

Why? UNI-FORM Panels can be erected faster, using less labor and material because the three basic elements of the UNI-FORM System—Panel, Tie and Tie Key provide simple mechanical assembly into any type of form. Unique system of attaching the minimum aligning lumber required reduces labor by 50% . . . pre-engineered techniques for handling pilasters, corners, stepped footings, columns, battered walls assure fast job progress.

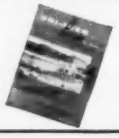
Steel framed, plywood faced UNI-FORM Panel

UNI-FORM TIE for any wall width

UNI-FORM Tie Key

3 simple elements in UNI-FORM SYSTEM

INTERESTED? Get the catalog and complete details on the UNI-FORM System today. Send us a set of plans for our recommendations. You will be money ahead, and there's no obligation.



P1500

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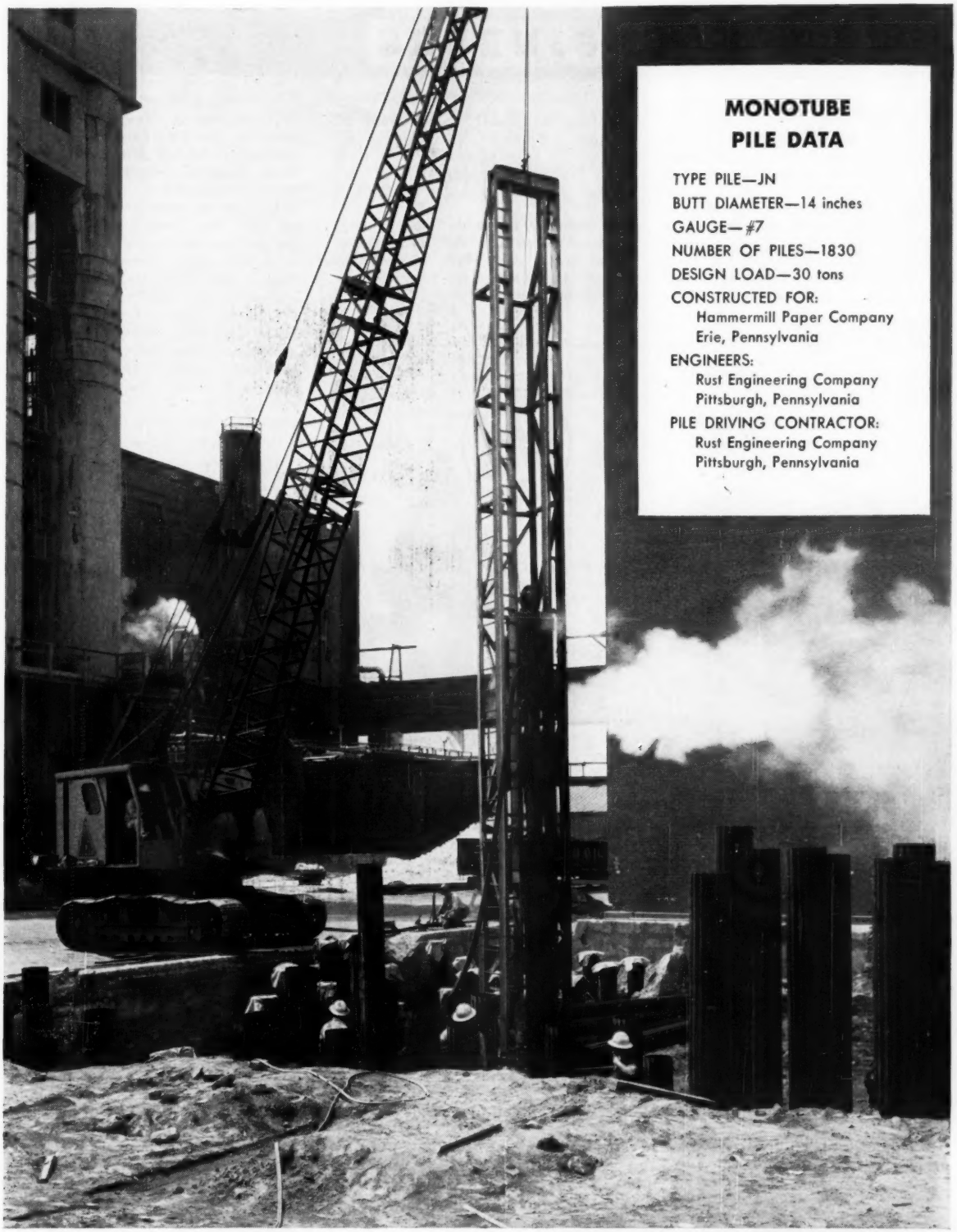


MONOTUBE PILE DATA

TYPE PILE—JN
BUTT DIAMETER—14 inches
GAUGE—#7
NUMBER OF PILES—1830
DESIGN LOAD—30 tons
CONSTRUCTED FOR:
Hammermill Paper Company
Erie, Pennsylvania
ENGINEERS:
Rust Engineering Company
Pittsburgh, Pennsylvania
PILE DRIVING CONTRACTOR:
Rust Engineering Company
Pittsburgh, Pennsylvania

DEPENDABILITY plus ECONOMY with Monotube piles. Fast installation of over 1800 Monotube foundation tubes is the progress report on this plant addition for Hammermill Paper Co., Erie, Pennsylvania.

Tapered, fluted Monotube piles are available in lengths, diameters and gauges to meet every requirement. Write The Union Metal Manufacturing Co., Canton 5, Ohio, for complete information.

UNION METAL

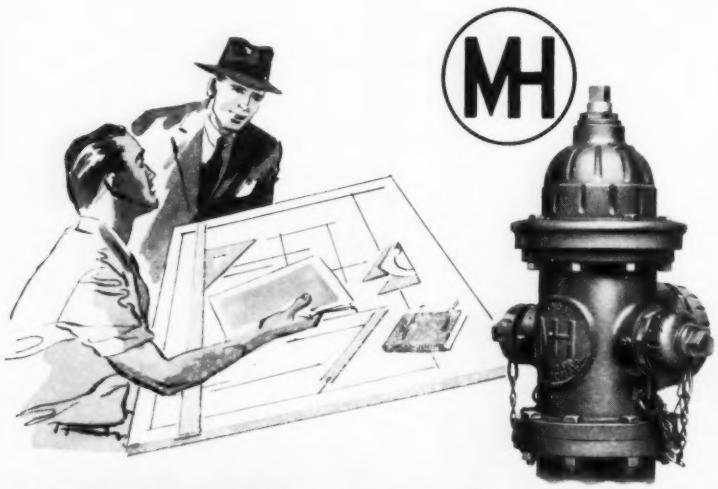
Monotube Foundation Piles

NEWS OF ENGINEERS

S. R. Fleming has been elected a vice-president of Ford, Bacon & Davis, engineers-constructors of New York, Chicago, and Los Angeles, and vice-president of Ford, Bacon & Davis Canada, Ltd. Mr. Fleming, who joined the firm 22 years ago, has had extensive experience in the design and construction of industrial plants and public utility systems. He is currently managing the company's Vancouver office.

Walter L. Huber and **Edward M. Knapik,** consulting civil engineers, announce the removal of their office to 57 Post Street, San Francisco, Calif. Mr. Huber is a Past-President of ASCE.

Edmond D. Burke has been appointed engineer of design for the Department of Highways in the District of Columbia. Mr. Burke has served the department for ten years in various capacities.



CUSTOMER Engineered

Modern engineering and practical water works experience account to a great extent for the advantages and superiority of M & H valves and hydrants. In this respect, many M & H customers are unofficial members of our engineering staff. From their every-day operating experience, these men "on the firing line" have contributed greatly to the modern design of M&H products.

We have gratefully accepted their contributions, which we have tested through years of research in engineering, design and foundry practice. The result is that M & H valves and hydrants are now widely known for their easy, practical and dependable service year after year.

For complete information, address

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

SUBSIDIARY OF WALWORTH

The Raymond Concrete Pile Company, of New York City, announces the promotion of two of its engineers. **Robert Nolan Bruce, Jr.,** engineer for the company at New Orleans, will take charge of sales for the firm in the Gulf of Mexico area. Mr. Bruce's experience with the company has been in prestressed concrete. His paper, "Prestressed Platform Built in Gulf of Mexico," appeared in the July 1956 issue of CIVIL ENGINEERING. Mr. Bruce is on the Louisiana Section's board of directors. **Myers Van Buren,** engineer in the home office, has been named prestressed products engineer to assist Charles B. Kiesel, Jr., manager of the firm's domestic and foreign prestressed concrete product sales.

Edward Carl Sword has been appointed to the staff of Lehigh University as assistant professor of civil engineering. Formerly an engineer with Arde Associates in Newark, N. J., Mr. Sword has done structural design for Parsons, Brinckerhoff, Hall and Macdonald of New York City.

Clyde M. Wood has been named to head the sales engineering training program of the "Automatic" Sprinkler Corporation of America, in Youngstown, Ohio. A veteran of 42 years with the firm, Mr. Wood has served it in many capacities in New York, Cincinnati, Youngstown, Cleveland, Atlanta, and Brazil.

William L. Uitti, assistant project engineer for Tidewater-Auchter, general contractors of Jacksonville, Fla., has become associated with Asphalt Paving, Inc., general contractors of Jacksonville, as projects manager.

Harold A. Hagestad, hydraulic and hydrology engineer for the Major Projects Division of the Tacoma Department of Public Utilities, has been advanced to the newly created post of coordinating engineer for the Tacoma Department of Public Works. In his new position, Mr. Hagestad will act as liaison between the Tacoma Public Works Department and all outside government agencies in relation to engineering matters.

Paul C. Benedict, regional engineer, Quality of Water Branch, U.S. Geological Survey, at Lincoln, Nebr., has been reassigned to Washington, D. C., where he will be chief of the Research Section of the Quality of Water Branch. Mr. Benedict is president of the Nebraska Section.

Paul Benedict

Current promotions in the civil engineering department at the University of Illinois include **John W. Briscoe** to professor and assistant department head, and **Don U. Deere** to professor. To associate professor: **John E. Baerwald, William J. Hall, John D. Haltiwanger, Narbey Khachaturian, Herbert O. Ireland, James M. Massard, Robert J. Mosborg, George K. Sinnamon, James E. Stallmeyer, Anestis S. Veletsos,** and **George A. Young.** To assistant professor: **Mete Avni Sozen,** and **Robert K. L. Wen.** To instructor: **George F. McDonough.**

Henry A. Sawchuk, formerly chief of the Natural Science and Engineering Section of the U. S. Civil Service Commission in Washington, D. C., has transferred to a highway engineer position in the headquarters of the Bureau of Public Roads. In his new assignment, Mr. Sawchuk heads the Traffic Services Section of the Construction and Maintenance Division.

Henry Sawchuk

Kenneth J. Carl, a supervisory engineer in the New York City office of the National Board of Fire Underwriters, has been appointed director of municipal surveys for the firm.

Donald S. Berry, formerly professor of transportation engineering at Purdue University, has been appointed professor of civil engineering at Northwestern University's Technological Institute, and to the staff of the Transportation Center there.

Harold O. Egeberg, of White Plains, N. Y., has been cited for "outstanding performance" by the Corps of Engineers. Mr. Egeberg is chief of the Estimating Section at the Army Engineer District, Eastern Ocean, in New York City.

Werner N. Grune, associate professor of civil engineering at Georgia Institute of Technology, has been presented with the Harrison Prescott Eddy Medal by the Federation of Sewage and Industrial Wastes Associations. Dr. Grune was honored for his paper, "Development of a Continuous Gas Chromatographic Analyzer for Sludge Digestion Studies."

Charles P. Lach, structural engineer for Burns and Roe, Inc. in Baltimore, has joined the staff of the Benjamin E. Beavin Company, Baltimore consulting engineers and surveyors.

Russell C. Brinker, formerly professor and head of the civil engineering department at Virginia Polytechnic Institute, and Rear Admiral, CEC, USNR, retired, has been appointed editorial director, Engineering Books, for the Ronald Press Company in New York.

John Guissinger, engineer with the Raymond Concrete Pile Company of New York, has been promoted to Puerto Rico district manager in charge of the activities of the company's subsidiaries there. Prior to his new assignment, Mr. Guissinger was chief engineer on the construction of foundations and approaches for the Second Narrows Bridge in Vancouver, B. C. Mr. Guissinger succeeds **Robert B. Finlay,** who has been named principal officer in the company's Venezuelan organization, Constructora Raymond, C. A., with offices in Caracas and Maracaibo.

Donald O. Covault, research engineer for Purdue University, has been appointed to the Highway Cost Committee of the Highway Research Board. Mr. Covault is at present working on his Ph.D. degree at Purdue University. Prior to his work there, Mr. Covault was employed for four years as a highway engineer with the Wisconsin Highway Department.

Spencer, White & Prentis, Inc., underpinning and foundation specialists, announce the appointment of two vice-presidents, **Albert DiGiacinto** and **Donald B. McKinley.** Mr. DiGiacinto has been with the firm since 1933, progressing through successive positions to that of general superintendent in 1952. Mr. McKinley was formerly with the firm, and from 1952 to the present time has been an officer and member of the consulting engineering firm of Charles H. Sells, Inc.

Celso A. Carbonell, for the past five years manager in Panama City for the Sika Chemical Corporation, of Passaic, N. J., has been promoted to executive vice-president and general manager of Sika Panama, S. A. In his new post, he will be responsible for the operations of the company in Mexico, Central America, Cuba, Haiti, the Dominican Republic, British and Dutch possessions in the Caribbean, Venezuela, Peru, Ecuador, Bolivia and Surinam. He is president of the Panama Section and former president of the Panama Society of Engineers and Architects.

C. A. Carbonell

John A. Miller, member of General Electric Company's laboratory staff in Schenectady, N. Y., has just had his fifth book published. The volume, entitled *Electric Power,* is a history of the development of the electric power industry and its influence on American living and industrial growth.

Harold S. Shaffer has established an office in Decatur, Ill., for the professional practice of civil engineering. He will specialize in the general field of soil mechanics, foundations, and related problems.

(Continued on page 26)

HELP
for engineers!
STANPAT—the remarkable tri-acetate that is pre-printed with your standard and repetitive blueprint items, easily transferred to your tracings by an adhesive back or front. Relieves time-consuming and tedious detail of re-drawing and re-lettering specification and revision boxes, standard symbols, sub-assemblies, components and cross-sections. Saves hundreds of expensive hours of drafting time and money, frees the engineer for concentration on more creative work.
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(Continued from page 25)

ASCE officers view ruins of the ancient Biblical city of Ephesus, near Izmir, Turkey, while on study tour in connection with the International Commission on Large Dams. In usual order are Past-President Gail A. Hathaway, and Vice-Presidents Waldo G. Bowman, Francis S. Friel, and Samuel B. Morris.

W. F. Reardon, engineer with General Electric Company of Schenectady, N. Y., working with design standards and review of real estate and construction operation in that city, has accepted an invitation to continue as a member of the Planning Committee of the Plastics Study Group of the Building Research Institute.

Peter Cartwright has been appointed supervising engineer of the Facilities Planning Section of Project Matterhorn, Forrestal Research Center, Princeton University. Project Matterhorn is a controlled thermonuclear research program sponsored by the Atomic Energy Commission.

Anthony Galioto, planning technician in the Port of New York Authority's port development department, has been promoted to highway project planner, a newly created position in the department. In this post, Mr. Galioto will work on studies concerning the construction of the second deck of the George Washington Bridge.

William R. Taylor has been promoted to civil engineer in the engineering division at Humble Oil and Refining Company's Baytown (Tex.) refinery. Mr. Taylor joined the firm immediately after his graduation from Mississippi State College in 1953, and has worked since in maintenance and design engineering.

Richard H. Wilson, assistant state highway engineer-administrator of the California State Division of Highways, has retired after more than 30 years with the division. Mr. Wilson has served as resident and district engineer, and at one time was maintenance engineer for District 1 at Eureka.

Louis H. Foote, Brigadier General, Army Corps of Engineers and division engineer of the North Pacific Division of the Corps since 1954, has retired after more than thirty years of Army service. Prior to his appointment as division engineer at Portland, General Foote was district engineer for the Alaska District and the Memphis District. While at Portland he directed the review investigation of the Columbia River "308" Report.

L. H. Foote

POSEY Large O.D.

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- Wrought Iron
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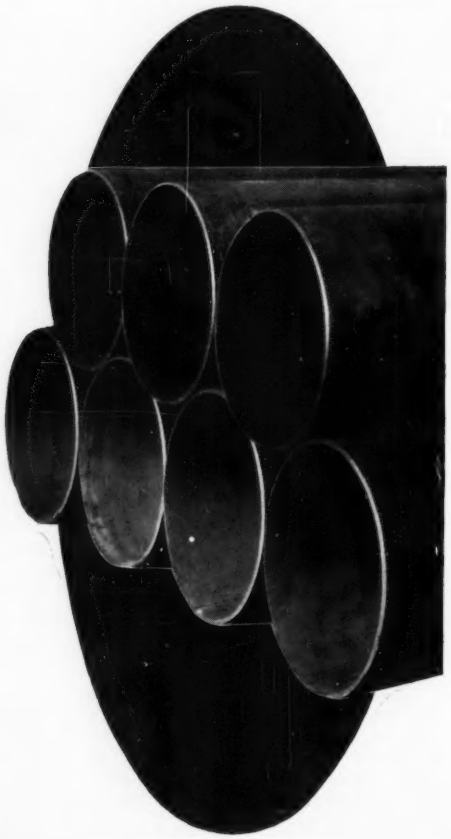

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RECENT BOOKS

(added to the Engineering Societies Library)

Regime Behavior Of Canals And Rivers

Constituting a first formal text on the science of "mobile-boundary hydraulics", the aim of this book by T. Blench is to develop and apply, to any river or canal capable of self-adjustment, the quantitative laws of formation of channels as a consequence of the movement of boundary material. Utilizing the observations of irrigation engineers, hydrologists, and geologists, the author presents formulas for various conditions of breadth, depth, slope, and bed load, and demonstrates their use in the type of complex problem presented by any shifting channel. Butterworths Scientific Publications, London, England, 1957. 138 pp., 30s.

Radiation Shielding

This book, by B. T. Price and others, is concerned with the basic physics of radiation and with practical considerations in the engineering design of shields for reactors, betatrons, synchrotrons, and linear accelerators. In the design section, the book deals with heat generation in shields, concrete shields, metal-hydrogen bulk shields, and shielding for radioactive materials during transport. The physics of radiation is covered in chapters on gamma ray attenuation, neutron physics, and neutron attenuation in thick shields. Selected references are listed after each chapter. Pergamon Press, 122 East 55th Street, New York 22, N. Y., 1957. 350 pp., $10.00.

Fasteners Handbook

For each fastener included in this complete handbook by Julius Soled, there is a picture or diagram and a paragraph or so on each of the following: description, features, uses, the standard material used in making the fastener and the standard sizes into which it is made. Anything unusual about the fastener or its use is given under "Remarks", and finally the name of the manufacturer is given. Types of fasteners include: rivets; inserts; screws, bolts and studs; nuts; washers; pins; nails; retaining rings; metal stitching; quick release fasteners; masonry anchoring devices; and hose clamps. An alphabetical list of the manufacturers with addresses is included at the end of the book. Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y., 1957. 430 pp., $12.50.

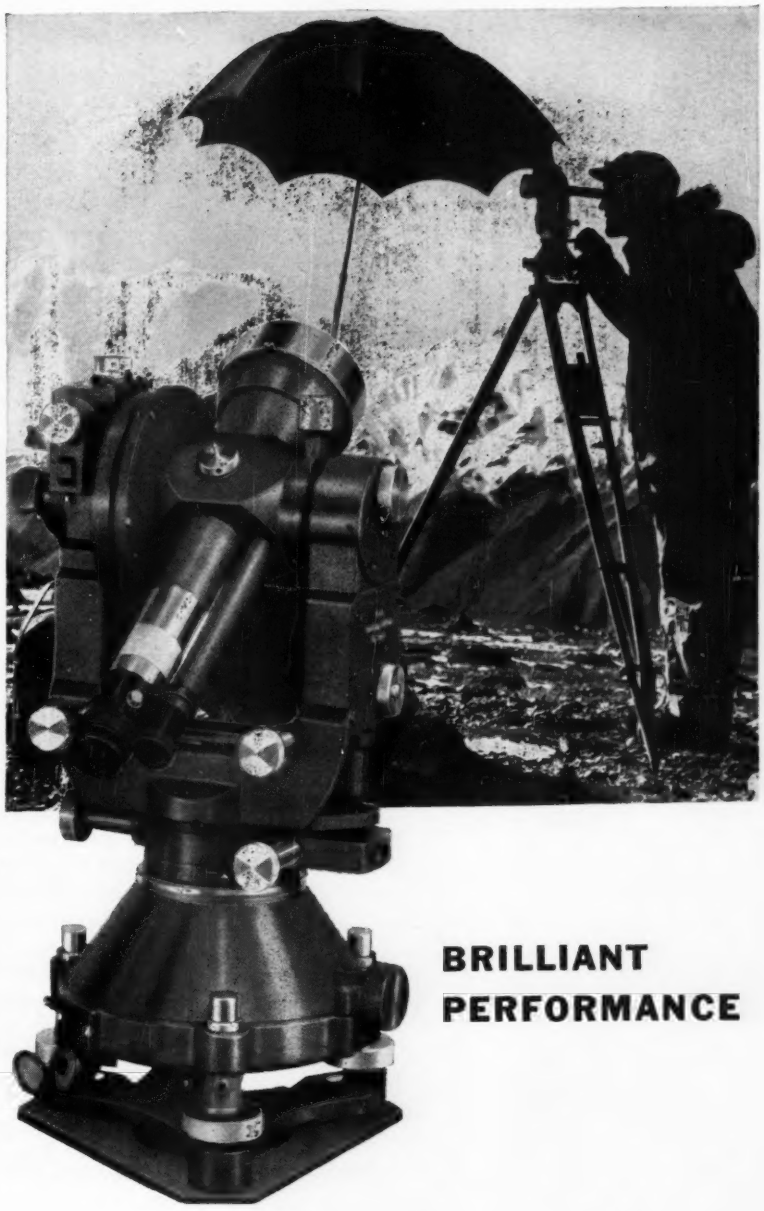
Design Of Steel Structures

Dealing with the design of structural members and their connections, and with applications to steel bridges and building frames, this book by E. H. Gaylord, Jr. and C. N. Gaylord, includes a thorough discussion of ordinary loads for these structures. It also covers design for earthquake and blast loads. The information on use of aluminum is relatively slight. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1957. 540 pp., $8.00.

Daylight Through The Mountain

Told largely through the letters of two brothers, this is the story of two civil engineers who built all the early main-line railways in Canada and some in the United States. They completed the Hoosac Mountain tunnel in Massachusetts without loss of life, after other contractors had given up the work due to loss of several of their workmen. Eventually one brother became a member of Parliment and the other the General Manager of the Grand Trunk Railway from Montreal to Windsor, Ontario. The book is edited by F. N. Walker and G. C. Walker. The Engineering Institute of Canada, Montreal, Canada, 1957. 442 pp., $6.00.

(Continued on page 113)



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500,000-gal. Horton Waterspheroid at Northbrook, Ill. It is 135 ft. to the top of the water line and the spheroid is 55 ft. 6 in. in diam.

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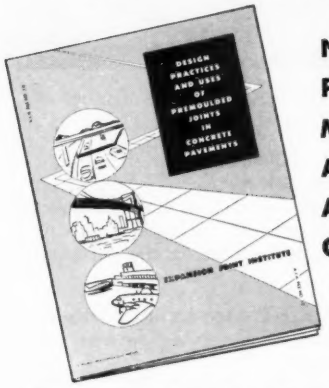

NEW "DESIGN PRACTICES" MANUAL AVAILABLE AT NO CHARGE!

The new manual, "Designing Practices And Uses Of Premoulded Joints In Concrete Pavements," features comprehensive technical data and illustrations of premoulded joint types, their applications and installations. Send the coupon below for your copy today!

The Expansion Joint Institute, an association of the major manufacturers of premoulded joint materials, was formed to conduct research in the manufacture, uses and applications of premoulded joint fillers. In addition, the Institute is the collecting, publishing and disseminating body for statistics and information of interest to the Institute members, the building industry and the public. Another objective of the new association is to promote and employ fair and equitable practices calculated to serve the best interests of those engaged in the construction industry who buy and use premoulded joints. The Expansion Joint Institute will cooperate in the adoption and maintenance of uniform and high specification standards in the manufacture of premoulded joint materials.

The newly formed Institute has already produced a manual, the first of its type, in answer to the many requests for a technical manual concerning the use of expansion joints.

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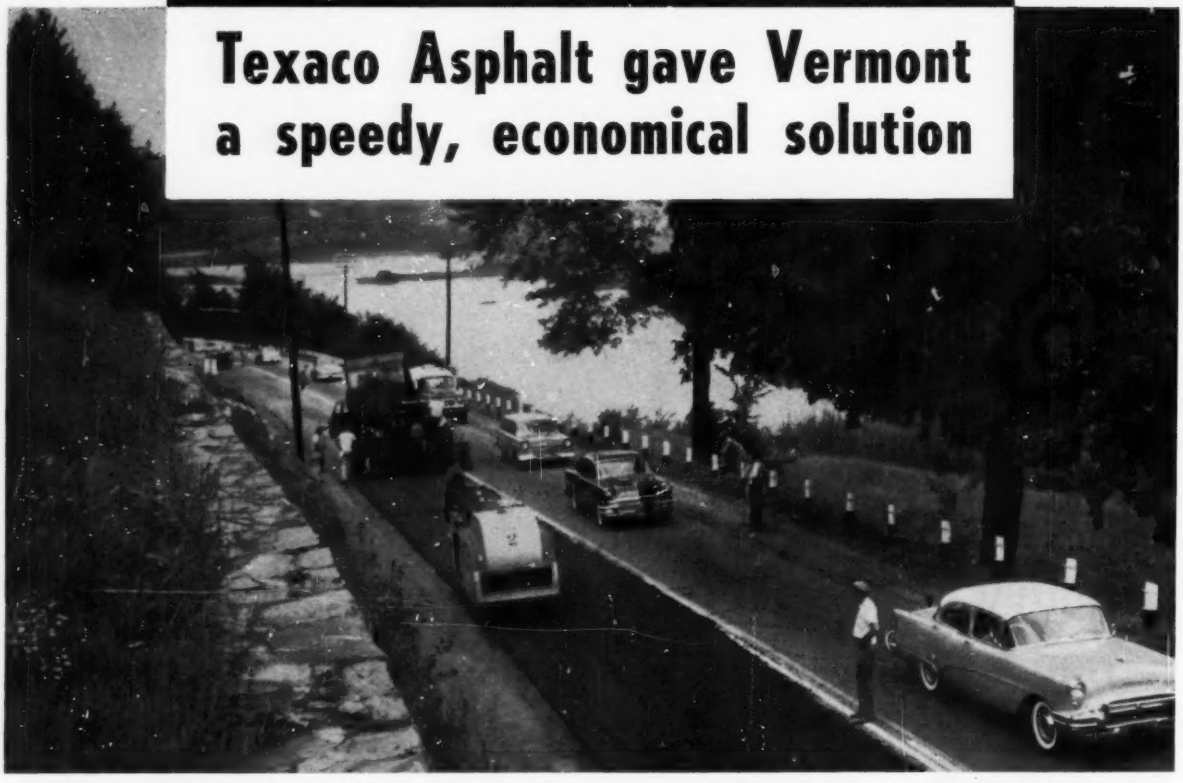
Texaco Asphalt gave Vermont a speedy, economical solution



Modernizing US-5 in Vermont with a plant-mixed Texaco Asphaltic Concrete wearing surface, laid without interrupting traffic.

CONTRACTORS

Cold River Hot-Mix Corporation, No. Walpole, N. H.

Frank W. Whitcomb Construction Company, No. Walpole, N. H.

MEMBER

U.S. Route 5, north of Bellows Falls, Vt., like thousands of miles of American roads, had a bituminous-treated gravel surface.

It was no longer adequate for today's traffic. However, because it had been thoroughly consolidated by years of service, it provided an excellent base. Without detouring traffic, this section of US-5 has been topped by a two-course pavement of plant-mixed Texaco Asphaltic Concrete, first a leveling course to true up inequalities in the old road, then a 1-inch wearing surface.

By this economical method, Vermont has converted an outdated road into a modern, heavy-duty highway, capable of serving present and future traffic with a minimum of maintenance.

Whether you are paving a highway or street, airport or parking area, there is a type of Texaco Asphalt construction exactly suited to your needs. These types range from heavy-duty, flexible pavements, consisting of asphalt base and asphalt surface, down to low-cost asphalt mats for light traffic. Helpful information regarding all of these asphalt types of construction is supplied in two free Texaco booklets. Copies may be secured without obligation by writing our nearest office.

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TEXACO

TEXACO ASPHALT

. . . . . Am-Soc Briefs

▶▶ Competitive bidding for engineering on a price basis is on the decline. . . . Basis for this optimistic opinion is the fact that, while thirty "incidents" of conflict with the Code of Ethics relating to bidding came to ASCE attention in 1955, so far this year there have been only seven. Public officials and engineers agree that engineers should be selected on the basis of ability to perform—certainly not on the basis of lowest fee. . . . A bulletin, "Negotiated Engineering Contracts Are in the Public Interest," presenting the Society's recommended procedures for obtaining the services of consultants, is available on request to the Executive Secretary.

▶▶ About the Engineering Societies Center. . . . The campaign for member gifts has not been formally launched. However, for those who wish to take advantage of income tax reductions for 1957 gifts, this is to say that contributions for the new building may be made before the end of the year. Checks should be made out to United Engineering Trustees and addressed to Executive Secretary Wisely at headquarters. . . . Information on the formal campaign for financing will be forthcoming. Past-President Enoch R. Needles represents ASCE on the intersociety committee for member gifts. . . . For background information on the new Center see the Society News lead in this issue.

▶▶ On the 1958 agenda. . . . Close at hand is the Chicago Convention, set for February 24-28. Arrangements being made by the host (Illinois) Section for a top Convention are reported in the Society News section. The January issue will carry the full program. . . . Looking ahead to summer, the Oregon Section stresses the opportunities for "fun, relaxation, and well-earned rest" at the Portland Convention (June 23-27) and urges members to bring the whole family for a "Conventional Vacation in the Pacific Northwest."

▶▶ On the program for next spring is a new ASCE Membership Directory, the first since 1956. . . . If you have moved, changed your job, or been promoted any time in the past two years, be sure to inform Society headquarters—for your convenience there is a coupon on page 112.

▶▶ At headquarters. . . . In line with recent Board action, the Society has established a public relations department, to be headed by M. O. Chenoweth, for the past fourteen years with Selvage & Lee, New York City industrial public relations counsel. . . . Another addition to the staff is Otis D. Gouty, J. M. ASCE, of Wichita, Kans., whose appointment as an assistant to the Secretary in the New York office, will permit expanded work with the Student Chapters and Local Sections.

This highway was sliding into the sea

Armco Retaining Walls stop erosion during wet weather

California's Route 99, along the Pacific Coast, was sliding 300 feet down into the ocean at three locations near Big Sur. The slides occurred in fill sections during wet weather.

Three Armco Bin-Type Retaining Walls were installed to stop the slides. The walls were 90, 100, and 140 feet long. After excavation down to a solid foundation, the steel bins were bolted together in place. Backfill was placed inside and behind the bins, and built up to roadway grade.

To maintain a dry, stable foundation, Armco Perforated Corrugated Metal Pipe was installed under the retaining walls.

Retaining Walls and Perforated Pipe are only two of the more than 30 Armco Products to help you solve drainage and construction problems. Write us for helpful data on Armco Construction Products. There is a qualified Armco Sales Engineer near you who will be glad to work with you. Armco Drainage & Metal Products, Inc., 5907 Curtis St., Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

A few of the many Armco Products for drainage and construction

Corrugated Metal Drainage Structures | Bridge Plank | Guardrail | Steel Buildings | Sheeting | Water Control and Sewage Gates | Armco Pipe Piling and Pile Shells... Welded Steel Pipe for Water Supply Systems

Armco Construction Products

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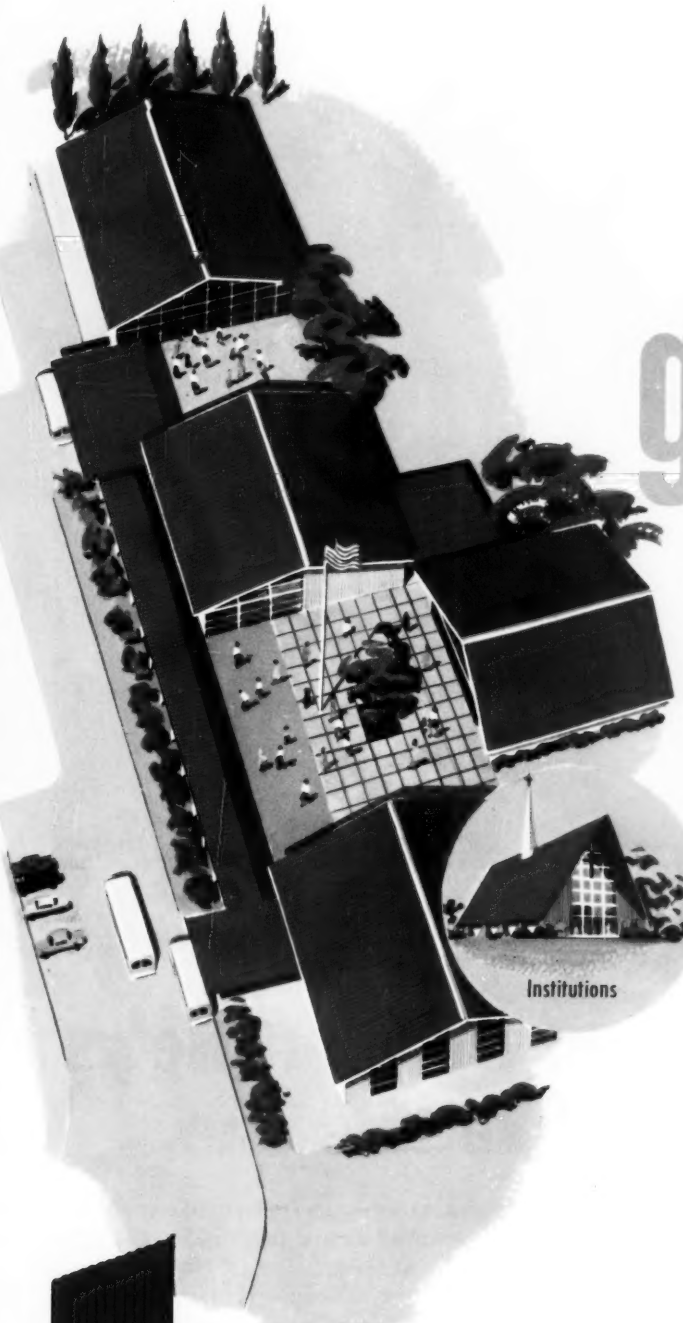
Follow the trend to pitched roofs with permanent

color galbestos



The growing tendency to return to the visible roof line for the purpose of economy and design embellishment in institutional, commercial and industrial buildings has been given impetus by the advent of Robertson's new Color Galbestos.

All the time-tested advantages of long service life, resistance to fire, corrosion, and extreme weather conditions that have made Robertson the world's standard of steel protection are now available in four new attractive colors . . . red, green, buff and gray in addition to the familiar black and maroon. Moreover, sparkling roof and sidewall color combinations are possible at a lower cost than any other type of maintenance-free product known. Write for literature.

With 150 trained sales engineers and 60 qualified service dealers, Robertson is ready to serve you in any part of the country. You'll always have the best technical assistance when Robertson products are specified.

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2400 Farmers Bank Building • Pittsburgh 22, Pennsylvania
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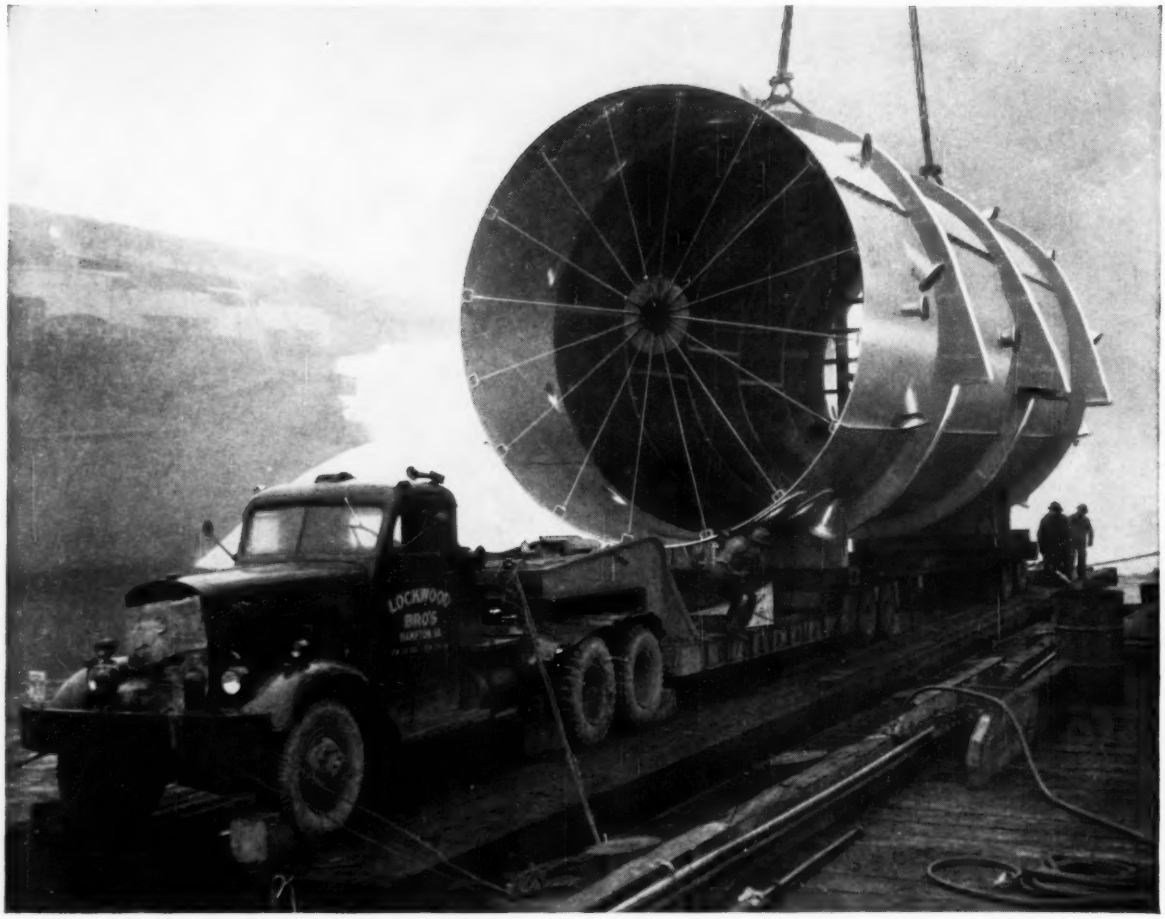

Unusual Handling Technique – Road clearances to Langley Field were not suitable for transporting the 53-foot long, 123-ton heat accumulator so Newport News made special loading and installation arrangements. The huge shell was first loaded on a "barged" trailer-truck and shipped to a location near the site. From that point it was pulled off by use of a ramp and hauled directly to the site where it was jacked into position.

Tap the resources of Newport News to fill an order like this one

This 123-ton, stainless clad Carilloy T-1 steel heat accumulator, (probably the first vessel made of this type steel), was built for the Langley Aeronautical Laboratory of the National Advisory Committee for Aeronautics. This *special purpose* unit incorporates 70 years of metal working experience. Decades of machining, welding, stress relieving . . . fabricating millions of tons of steel into thousands of diverse products.

This experience goes into every unit built by Newport News . . .

Into products that range from small components of textile machines, to the giant 165,000 hp hydraulic turbines at Grand Coulee. Newport News is a source for standard or special plate fabrication, castings, forgings, weldments and sub-assemblies. Particularly, large units . . . single or multiple. Your inquiries are invited.

A brand new, easy-to-read, illustrated booklet, *Facilities and Products* will show you scores of ways in which Newport News can help you. Send for it today.

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Engineers – Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

do you know that

Canada is pushing its transcontinental highway? With the opening this fall of a 406-mile stretch of road across the prairie province of Saskatchewan, Canada's 4,572-mile ocean-to-ocean highway takes a long stride toward completion. Some of the most difficult terrain on the continent has delayed construction, with the result that the entire road will not be open until the end of 1960 instead of late 1959, as originally planned. The Saskatchewan section took three years (the clayey soils caused stabilizing problems) and cost more than $27,000,000. The federal government is putting up 90 percent of the money needed for the first 10 percent of the mileage, and 50 percent of the cost of the remainder.

• • •

Two trench-type subaqueous tunnels are being completed this November? With the opening of the Hampton Roads (Virginia) Bridge-Tunnel early in the month and Maryland's Baltimore Harbor Tunnel at the end of the month, there are thirteen tunnels of this type in the world—twelve in the United States and one in Europe. Dedication of the two-lane 3½-mile-long Hampton Roads Tunnel, the world's sixth longest subaqueous crossing, is reported in the "News Briefs" section. The Baltimore Harbor Tunnel is the first twin tunnel of the trench type.

• • •

The index of average bid prices for federal-aid highway construction in the third quarter remained about the same as in the preceding quarter? With 1946 as a base year, the price index rose from a low point of 125.5 in the second quarter of 1955 to 142.8 in the third quarter of 1957, a total increase of 13.8 percent. The figures are based on federal-aid highway construction contracts awarded by state highway departments and reported to the Bureau of Public Roads.

• • •

Washington, D. C., is searching for a second airport site? Spurred by five near plane collisions on the crowded approaches to its only commercial airport, the nation's capital is stepping up its quest for a suitable site by use of electronic tabulating equipment, which pretests problems of air-traffic control at different locations.

• • •

The average engineering teacher in American colleges and universities earns $6,634 a year? He augments this salary ($550 a month) with consulting and other engineering work to bring his total annual take to $8,862. He earns more if he teaches in a privately endowed institution than in a public institution, and he earns more on the Pacific Coast than anywhere else in the nation. Source of these statistics is a new study of 1956 salary figures made by the American Society for Engineering Education.

• • •

Water cooled reactors give best promise of producing atomic power, at prices competitive with fossil fuels, within the next ten or fifteen years? Large boiling and pressurized water reactors are thought to be capable of producing power at competitive prices—that is, 10 to 14 mills per kwhr. According to Kenneth Davis, director of reactor development for the AEC, "it does not appear likely that such reactors as the aqueous homogeneous, fast breeder, liquid metal fueled, sodium-cooled graphite, or liquid plutonium [reactors] can be successfully exploited commercially by so early a date."

• • •

The Federal Government is spending about $3 billion annually on scientific research and development? The Defense Department and Atomic Energy Commission accounted for 85 percent of research and development spending in fiscal 1957. More than 60 cents of every dollar went for development—or the use of scientific knowledge "to produce new items, from pills to missiles." Less than 40 cents of every dollar went for basic research and study leading toward the discovery of new scientific knowledge. Source of this estimate is the National Science Foundation.

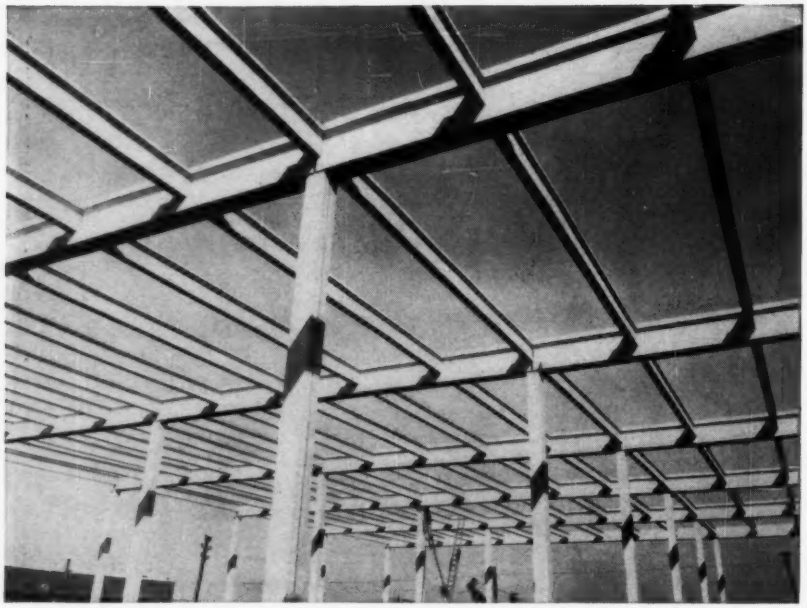
• • •

Motor vehicle registrations continue to gain? In 1957 they will reach 67,204,000, Federal Highway Administrator Bertram D. Tallamy announces. Passenger cars will number 56,101,000, a 3.3 percent increase over 1956, while trucks and buses will total 11,103,000, a gain of 2 percent. Florida once again leads in registration increases, with 10.5 percent, followed by Arizona and Nevada with respective gains of 8.4 percent and 6 percent. California has the most vehicles, almost 7,000,000, and New York is second, with an estimated 4.8 million.

• • •

Pulverized ash can be converted into building material? Power engineers have their eyes on a sintering plant installed in London's giant Battersea power station, which is turning pulverized fuel ash into lightweight concrete aggregate known as Terlite. In successful operation for several months, the plant has an annual output of some 100,000 tons of aggregate in three grades from ¾ in. down.

FRAMEWORK OF THE FUTURE IS GOING UP *Today!*



New "Savarin" Coffee Plant of Slim, Clean Precast Concrete is Functional Beauty

● This bright, light, efficient plant is proof of modern concrete's versatility, speed and economy of erection. The 130 columns, 95 girders and 425 purlins went up in just 7 working weeks.

CHECK THESE CONCRETE FACTS

Here's what architect and owner want in a new building. Here's what precast and prestressed concrete gives them:

- a maintenance-free, corrosion-free structure
- elimination of fire hazard, hence favorable insurance rates
- streamline, smooth surfaces easy to keep clean, new-looking and sanitary
- flexibility for expansion through variety of shapes, sizes and weights made-to-order at no premium cost
- economy through speedy erection in days or weeks, from on-job or off-job casting plants
- immediate availability of units, produced as needed
- quicker starts, earlier finishes by using 'Incor' high early strength cement, in assembly line production through fast stripping and re-use of forms

Dependable 'Incor'*, America's first high early strength cement, is a major reason why precast, prestressed buildings such as this are the Framework of the Future rising everywhere *Today*.

*Reg. U.S. Pat. Off.

Architects: **POMERANCE & BREINES**, New York City
Structural Engineer: **HARWOOD & GOULD**, New York City
General Contractor: **WALTER KIDDE CONSTRUCTION COMPANY**, New York City
Precast Sections: **FORMIGLI CORPORATION**, Williamstown Jct., New Jersey plant

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CIVIL ENGINEERING

HORIZONS in ENGINEERING

D. B. STEINMAN, M. ASCE, Consulting Engineer, New York, N. Y.

Our one lesson from past experience is never to underestimate the future of engineering progress. Each new discovery opens tremendous vistas of further invention and application. The quickening tempo is logarithmic. Each new generation, building on the past, sees more progress in science and engineering than was recorded in all the preceding centuries.

Before the dawn of history, the greatest engineering achievement was the invention and application of the wheel. This was man's first great improvement on nature. The prehistoric genius who hit upon this apparently simple invention could not have visualized the vast future significance, the amazing vistas of mechanical progress it would make possible. Hardly any subsequent engineering advance would have been possible without the wheel in its manifold developments, symbolized by all the indispensable wheels of industry, transportation, and power.

In 1943, Henry L. Ellsworth, U. S. Commissioner of Patents, wrote in his Annual Report to Congress:

"The advancement of the arts, from year to year, taxes our credulity and seems to presage the arrival of that period when human improvement must end." If the Commissioner had been a mathematician, he would have known the elementary fact that an expanding series can never approach a limit but must continue to expand to infinity.

It took forty years (from 1889 to 1929) to increase the length of the world's record bridge span by only 150 ft, from the Forth Bridge in Scotland with a 1,700-ft span to the Detroit-Ambassador Bridge of 1,850-ft span. In the next eight years, in two bold jumps, the world's record span-length was more than doubled, with the George Washington Bridge (1931) of 3,500-ft span and the Golden Gate Bridge (1937) of 4,200-ft span.

In the ten years from 1930 to 1940 there was more progress in bridge engineering than in all the centuries preceding. This included new bridge types, new record-breaking span lengths, new materials, improved methods of analysis, and new erection methods. We are now working on bridge projects with unprecedented span lengths of 5,000 to 6,300 ft, and bridge engineers now agree that span lengths of 10,000 ft are well within the range of feasibility.

We are living in a wonderful age of engineering progress. In our generation we have seen the invention and development of the X-ray, the phonograph, motion pictures, wireless, dirigibles, airplanes, radio, color photography, television, and thousands of other things scarcely conceivable by former generations. New triumphs of engineering have made this possible—mass production, the assembly line, automatic machines, and interchangeable parts. We now have automation, electronic computers, cybernetics, guided missiles, jet planes, and rockets, and we are going on to satellites, flying saucers, platforms in space, space ships, interstellar communication, and interstellar travel.

When Einstein set forth his famous conversion formula, he dared to turn his back on three centuries of scientific thinking. Because a small group of men accepted his conclusions and were willing to proceed on the assumption that $E = Mc^2$, a city was destroyed, and the history of the world changed. Now we know that matter and energy are convertible, and we have entered into a new era of science and invention—and constructive progress—the Atomic Age.

Each new invention of widespread adoption, for travel, pleasure, or entertainment, creates new jobs for many thousands or millions. Our generation has witnessed the vast new industries and occupational interests created by the automobile, the airplane, the motion pictures, the radio, and television. There will be no lack of job opportunities as long as there are human needs, interests, and desires to be satisfied.

One of the most important engineering tasks ahead is to establish weather and climate control so we can protect our crops from drouth and frost, prevent floods, and ensure adequate food supplies for all the world at all times. We will soon be drawing power, food, drinking water, and chemicals from the sea.

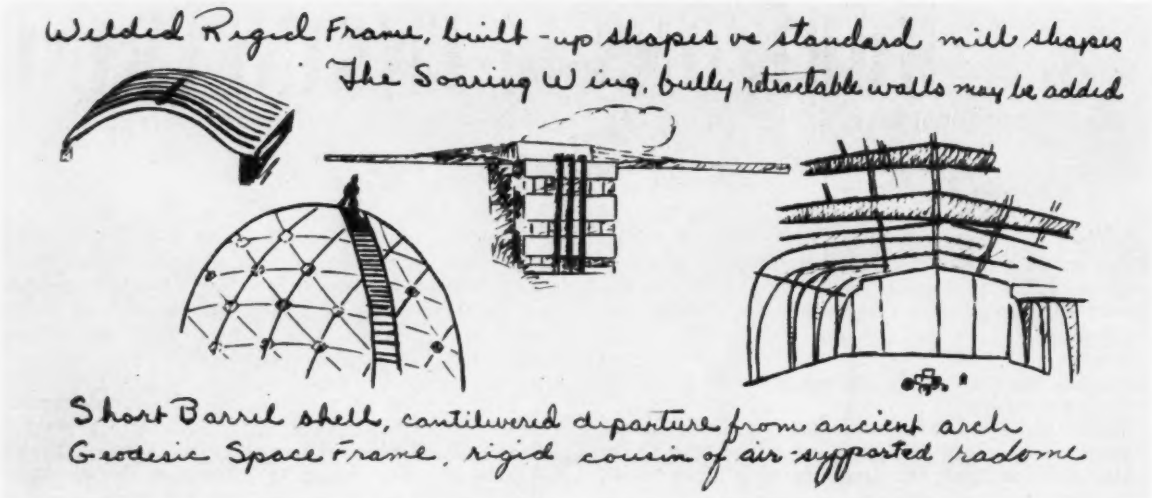
As long as human ingenuity and engineering resourcefulness exist, we need never fear depletion of our present natural resources as a threat to survival. The resources of God's universe and the resources of the human mind are unlimited. All we need is the vision to see beyond the horizon.

Horizons are not boundaries. The horizon is merely the line of tangency circumscribing that which is immediately visible. There are always much vaster areas beyond the horizon. When we stand on the seashore, our horizon is a circle of three-mile radius. When we ascend to the top of the Empire State Building, our horizon is enlarged to a radius of forty-one miles. The area of our field of view is increased two-hundred-fold.

Each gain in science or technology increases the certainty of further advance. The future of engineering is to be gaged not by the past but by the problems still unsolved and the possibilities yet to be conceived and explored.

(From Dr. Steinman's address at the University of Florida, following dedication of the David B. Steinman Faculty Lounge)

Eliminating structural interferences


Welded Rigid Frame, built-up shapes vs standard mill shapes
The Soaring Wing, fully retractable walls may be added
Short Barrel shell, cantilevered departure from ancient arch
Geodesic Space Frame, rigid cousin of air-supported radome

The trend is toward wide spans and roomy construction for factory buildings. The aircraft industry, impelled by necessity, has shown that column spacings can be increased from 50 ft to over 100 ft without a prohibitive increase in cost. This industry says to the structural engineer:

"We want a very large floor area. Put a roof on it. Support the roof at the four corners only, as structural interferences in the working area cannot be tolerated. Make the peripheral access absolutely free for maneuvering large equipment in and out of the area.

"Walls? Yes, we want walls, but they must be fully retractable all the way across the side of the building. On second thought, it would be better to support the roof from one end only, leaving three sides and the working area entirely free from structural interferences (as in the case of the soaring wing-like hangar roofs at New York International Airport)."

Factories with assembly lines, supermarkets, auditoriums and department stores—all found the idea of wide spans attractive. The S. H. Kress & Company, in its Fifth Avenue (New York) store, has a clear span of 100 ft on the main floor.

Advantages of the wide-span structure are many:

1. Its appearance is impressive and attractive to the public and to the factory worker whose esthetic responses to the uncluttered and airy enclosure are important.

2. Unlimited adaptation to changes in process is possible where the factory area is free of structural members. In a large number of factories, columns spaced to fit specific machinery installations will become obsolescent in a few years, when the machinery becomes obsolete.

3. Placing of ducts and trenches under the floor has eliminated the complicated and imposing tangle of utilities that used to be located overhead. This makes it unnecessary to utilize columns and beams for the support of utilities.

4. Heating facilities are removed from the working area. Radiant heating and forced convection heating are scientifically applied only where wanted. The absence of structural interference is advantageous in the installation of both these modern means of comfort heating where uniform distribution is required. This is also true of comfort cooling and humidification.

5. The high vaulted roof characteristic of many long-span installations can be beneficial in both heating and cooling, as the units can be fewer in number and can provide better distribution when installed high above the working floor. There is a slight increase in the heating and cooling load for this type of construction, about proportional to the increase in roof area in, say, thin-arch construction, as compared to flat-roof construction. Fan power requirements also tend to increase somewhat with increase in ceiling height.

6. Illumination, cooling, and heating units can be concealed or recessed under the roof; or more frequently, they are continuous or in unit form in a dignified and orderly pattern, exposed high above the work area. Thus they can be easily modified to suit changing process requirements or other needs.

7. A certain amount of labor saving can properly be credited to the elimination of structural interferences in the work area. Consider the extra effort involved where hundreds of men

in the modern factory

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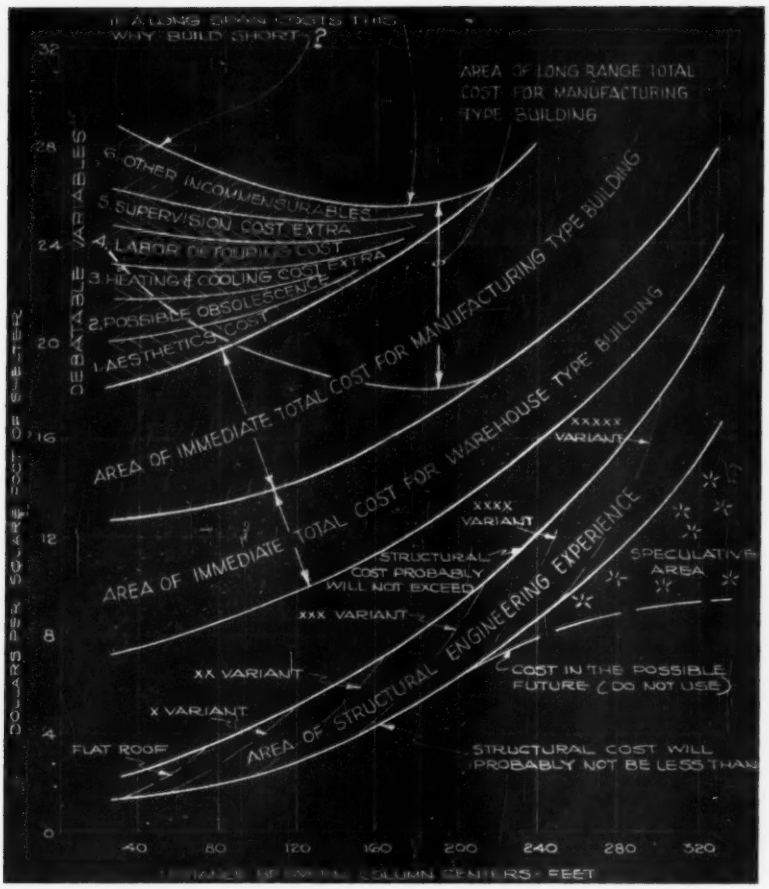


FIG. 1. These generalized curves are intended solely to guide the designer in making a set of curves for a specific structure. The uppermost curve in each group is the most important. And the pitch is more important than the dollar values. Similar evaluations should support any new factory design.

walk around, and peer around, columns several times a day for twenty or thirty years.

8. Supervision from monitoring stations is assisted by clear visibility throughout the area. Offices located on a small mezzanine in a clear-span working area will enable supervisors to continuously inspect every operation. Pinpoint television close-ups enhance such monitoring, it is true, but the birdseye view gives perspective.

A disadvantage of wide-span construction is that it costs more. The structural cost is likely to increase from about 15 percent of the total building cost for short spans to as much as 35 percent for spans exceeding 100 ft. Depending on the value of the advantages sought, the additional expense is frequently justified.

The requirements of the insurance underwriter as to the distance between fire walls may determine the maximum span. Smoke screens, which zone the upper areas without interfering with the floor space, are sometimes acceptable to the insurer.

A logical extension of a study of unobstructed floor areas would include flexible radomes for covering manufacturing operations. Studies have been completed on sizes up to many hundreds of feet in diameter for special applications, and it is understood that a comparatively small one is being installed to shelter a factory in the New England area. Lack of materials of proven durability, as well as storm hazards, usually eliminate this type of structure from consideration at present. The development of suitable materials for this large market is now squarely up to the fabrics manufacturer.

It is not practicable to express many of the advantages of wide-span construction in terms of dollars and cents. But the fact that they cannot be exactly measured is no reason why they should be omitted completely from the balance sheet—as they often are. These are the credit items. Much —if not most—of the engineering progress made in the past amazing decade is a result of budgets prepared and justified by pioneering in the evaluation of incommensurable benefits.

The debit column is more easily added up. In the case of column spacing, an averaging of detailed experience gives generalized costs, as shown in Fig. 1. The wide-band curves bracket the spread of engineering choice, owner's requirements, local construction conditions, and other variables. The pitch of the generalized curves is perhaps more significant than the values themselves in arriving at a preliminary decision to increase the clear span in a factory.

The final decision can then be reached on the basis of engineering designs and estimates which consider the client's needs and desires—all of them—including the incommensurable, debatable variables. These latter must be superimposed on the *immediate* building cost, or the choice of the structure for *long-range* operating usefulness is not realistic. This choice will require the concentration and agreement of several talents.

Great Salt Lake Crossing

New sampler speeds design of

H. V. ANDERSON, J. M. ASCE, International Engineering Company, Inc.,

Planning the new Great Salt Lake crossing of the Southern Pacific Railroad required an extensive study of the existing facilities and their possible future, and a study of the possibility of supporting a fill on the lake-bottom clays. The Swedish foil sampler proved very adaptable in providing undisturbed samples of the clay from which soil-strength characteristics could be determined. Through a series of investigations, it was found feasible to replace the existing trestle with a rock fill.

For many years the Southern Pacific has foreseen the necessity of rebuilding its Great Salt Lake cutoff. In August 1953, it contracted with the International Engineering Co., Inc. (IECO) for a study of the engineering and economic factors involved in the reconstruction or replacement of the crossing. This work included taking undisturbed samples and making foundation borings, laboratory tests, analyses, engineering design, cost estimates, and economic studies.

The early railroad builders avoided the problem of the soft clays in the bottom of Great Salt Lake by building the original route around the north end of the lake instead of across it. Although the advantage of a route across the lake was always realized, it was not until 1902 that the construction of the Lucin Cutoff was finally undertaken. Rock was hauled from quarries at each end until foundation failures of the soft clays halted the operation. Only then did construction of a wooden trestle begin.

Although the lake was no more than 20 to 35 ft deep, wood piles 120 ft long were used for 11,000 ft at the western end and 1,500 ft at the eastern end. The remainder of the trestle rests on shorter piles, driven to refusal on the salt stratum. The 12 miles of wood trestle and the 11 miles of rock fill, comprising the main part of the project, were completed in less than two years. Even making no allowance for the type of equipment available in 1904, this was a construction marvel.

The wood trestle across Great Salt Lake has had a long life. The salt brine of the lake is a natural preservative. No living organism except brine shrimp exists in it. No insect will harm wood that has been immersed in the lake. After continual soaking, wood fibers become hard and brittle and do not decay. Freezing and thawing action is limited. Concentrated salt water has a less corrosive effect on iron than sea water, so the bolts used in the trestle are in much better condition than would normally be expected after fifty years of service.

Despite the preservative effect of the salt, many timber members have had to be replaced. A new deck, helper stringers, and horizontal bracing struts were added between 1920 and 1927. To keep up with the increasing size of trains and freight loads, it has been necessary to strengthen the bents and increase their size. Bracing piles were added from 1943 to 1946 to provide additional longitudinal rigidity.

A fire destroyed 645 ft of double-track trestle in 1956, after construction had started on the new fill. The piles, thought to be fire-resistant as a result of continual soaking with salt water spray, were destroyed as the fire consumed their centers. The bents were rebuilt by placing prefabricated ponybents on the original piles after the burned upper sections had been sawed off.

The original fills in the lake, dumped on the unstable clay bottom, have required expensive maintenance. The rock fills settled for years after placing. Severe storms, which occur frequently on Great Salt Lake, have subjected the fills to destructive wave action. To prevent water from washing them away, concrete paving was placed over the rock. Finally, huge limestone riprap was built up on the sides. Even though the fill material has been eroded and there are flat slopes below the water surface, which assist in maintaining stability of the riprap, the fills still require maintenance.

Repair or replace is question

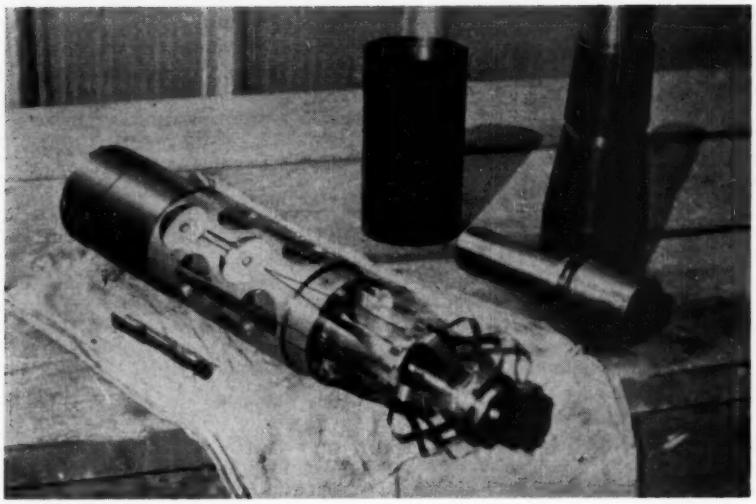
Mounting maintenance costs, the necessity of redecking the existing trestle in the immediate future and about every 25 years thereafter, plus need for the replacement of the timber piling in the next 25 years, dictated a thorough study of the problems and possibilities to find some other means of crossing Great Salt Lake. The following plans were studied:

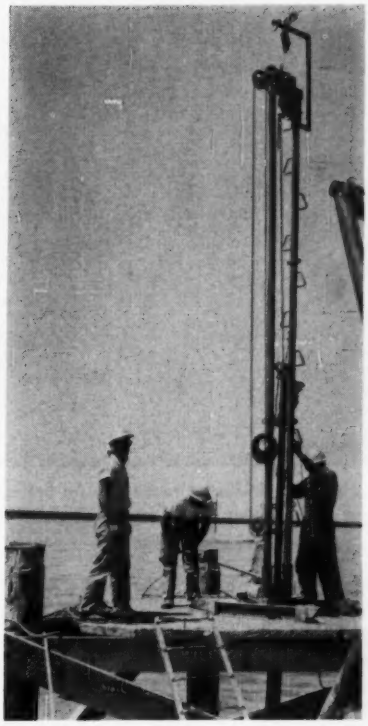
1. Redeck existing trestle and replace with a new trestle after 25 years
2. Reconstruct a new trestle and redeck it after 30 years
3. Construct a new parallel trestle and redeck existing trestle
4. Redeck existing trestle and construct a rock fill after 25 years
5. Construct a rock fill with 3,000 ft of trestle
6. Construct a rock fill with 24,000 ft of new trestle
7. Construct a concrete trestle
8. Build a rock fill 13 miles long

The key factor in determining the most economic means of crossing the lake is the clays which make up the lake bottom and which must provide the foundation for any fill or structure. In the past these clays have been responsible for the settlement of the fill, for slides and slip-outs, and for erosion of the support used for slope-protection materials. Failure of these clays to support fill in 1902 resulted

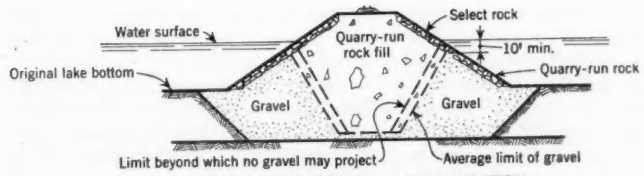
31,000,000-cu yd fill

San Francisco, Calif.

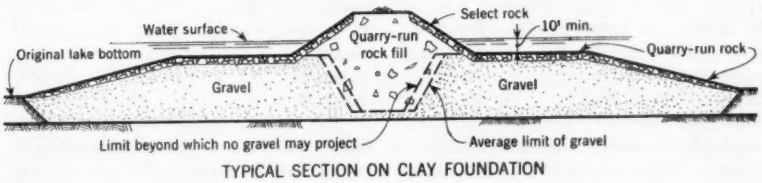




In foil sampler, at left, thin metal foils from reels in head come in contact with soil as it enters sampler and move upward with it as sampler is lowered. This Model VII Swedish sampler is very similar to that used for work described. In view above, foil sampler is forced down into clay by a grip-hoist. Mechanism of sampler includes dial gage, which shows tension on foils, controlled by hand wheel.

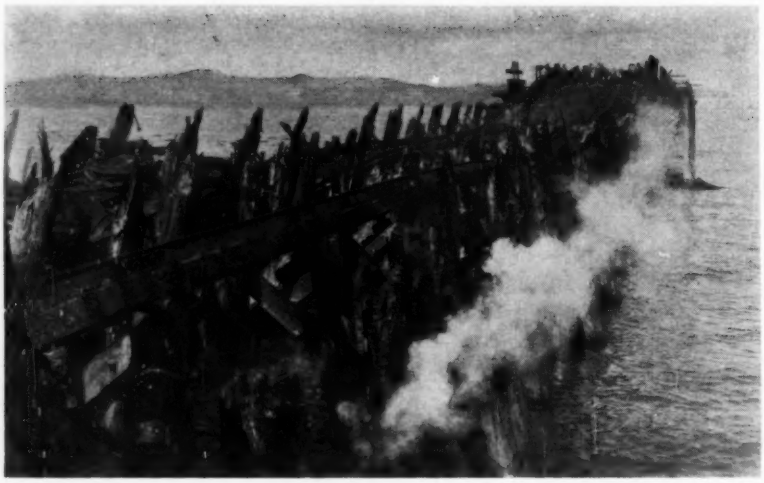


TYPICAL SECTION ON SALT FOUNDATION



TYPICAL SECTION ON CLAY FOUNDATION

FIG. 1. Gravel blanket up to 400 ft wide helps support rock fill where lake bottom is soft clay. On thick salt layer in center of lake, width of blanket is generally less than 200 ft. Fill has top width of 38 ft and varying depth—about 70 to 75 ft in central section.



Supposedly fire-safe trestle caught fire after work on new fill had started. Railroad and construction crews pooled their efforts to rebuild 645-ft section in one week.

in construction of the costly timber trestle, which is susceptible to fire and earthquake and unsafe for fast freight traffic.

Study of these underlying clays was the first step in determining the probable cost of a crossing. Borings were made through the existing fill at the approaches to the trestle to determine the depth to which the rock had displaced the clay. Undisturbed samples of the consolidated clay were also obtained, using 2½ and 3⅛-in. Shelby tubes. Other samples were taken from the trestle in the center of the lake to provide representative undisturbed clay for the determination of shearing strength.

This preliminary investigation indicated that the foundation clays were suitable for the construction of a "floating" rock fill. However, consolidation was expected to result in 10 ft of settlement of the fill after construction. It was recognized that an extensive investigation of the clay would be required for design purposes if a rock fill were to be built without danger of severe overrun of quantities.

From these studies it was concluded that the annual cost for reconstruction and redecking of wooden trestles would be nearly as much as that for the construction of a rock fill. However other factors, such as a fireproof structure, full-speed train operation, and a permanent facility, made the fill much preferable. See Fig. 1.

In 1954 a seismic survey was made of the proposed crossing by Fisher Research Laboratories for IECO. No subsurface strata of rock were found but the deposit of crystalline Glauber's salt was outlined. This deposit extends across the center of the lake for a distance of some 5 miles.

A hydrographic survey of the proposed crossing was made by IECO in 1955 to determine the economic location for the fill and the approximate quantities of gravel and rock necessary. Borrow sources of fill were located, and topographic maps of the area prepared to aid planning of construction facilities.

In 1955 the underlying salt layer was cored from the trestle at 13 different locations to determine its depth and extent. Vane shear tests of the soft clays were also made from the trestle. Two independent crews of the Selby Drilling Corp. took the samples. One crew used an apparatus designed by the U. S. Bureau of Reclamation, consisting mainly of a gear-reduction drive unit, N-casing, A-rods and the vane. The other crew used an electronic recording vane which eliminated the necessity for a casing but required the use of a Sanborne recorder.

Five permanent platforms were constructed across the lake on the proposed centerline of the fill. It was desirous to work several days at each location and it was found necessary to build permanent platforms. These structures, each 30 ft square, consisted of wooden piling, 12-in. × 18-in. stringers and 4-in. decking. The deck was 10 ft above the water surface for protection from wave action. Vane tests, penetrometer tests, and undisturbed samples were taken at each location. The penetrometer used was an electronically recording device which provided a continuous record of resistance encountered by the piston. The relationship between the results obtained by the vane and those obtained by the penetrometer at platforms No. 1 and No. 2 are shown in Fig. 2.

The Sanborne recording instrument was very susceptible to the salty atmosphere. Because of the operation difficulties of the electronic equipment, the USBR vane shear device was selected for most of the work.

The undisturbed samples were obtained by using a 3-in. Hvorslev piston sampler developed by the USBR. A soils laboratory was set up at the job site, where unconfined compression tests, quick triaxial compression tests, consolidation tests, determinations of water content, density and Atterberg limits were made from the samples. The relationship between the vane tests and the laboratory tests for shear strength is shown in Fig. 3. After a review of the laboratory results, it was decided that unconfined compression tests of carefully taken undisturbed samples would be used for future shear-strength determinations of the foundation clays.

Additional data were needed to assure that the most economically safe section would be selected for crossing the soft clays. A Swedish development, the foil sampler, was used by IECO in 1956 to take continuous undisturbed clay samples up to 50 ft long, of the lake bottom in depths of water up to 35 ft.

The foil sampler

The principle of the new sampler is to insulate the core and protect it from the sampler wall by means of thin axial metal foils. The upper ends of the foils are attached to a piston-brake mechanism above the core. The lower ends unwind from 16 different rolls which are held in the sampler head. As the sampler head advances, the foils are pulled through guides and follow up along the perimeter of the core. The foils not only eliminate the friction produced by sliding but retain the physical properties of each soil layer encountered.

Success of the sampling operation depends upon the contact between core and foils. Since the foils must enter the sample tube at the same rate as the sample, tension on the foils must be applied systematically. This is done by adjusting the level of the piston-brake mechanism. Special measures may also be required for sampling in expansive soils, very soft or very firm cohesive clays, or permeable cohesionless soils.

The sample tubes may be divided into 8-ft sections and transported to the laboratory for immediate testing.

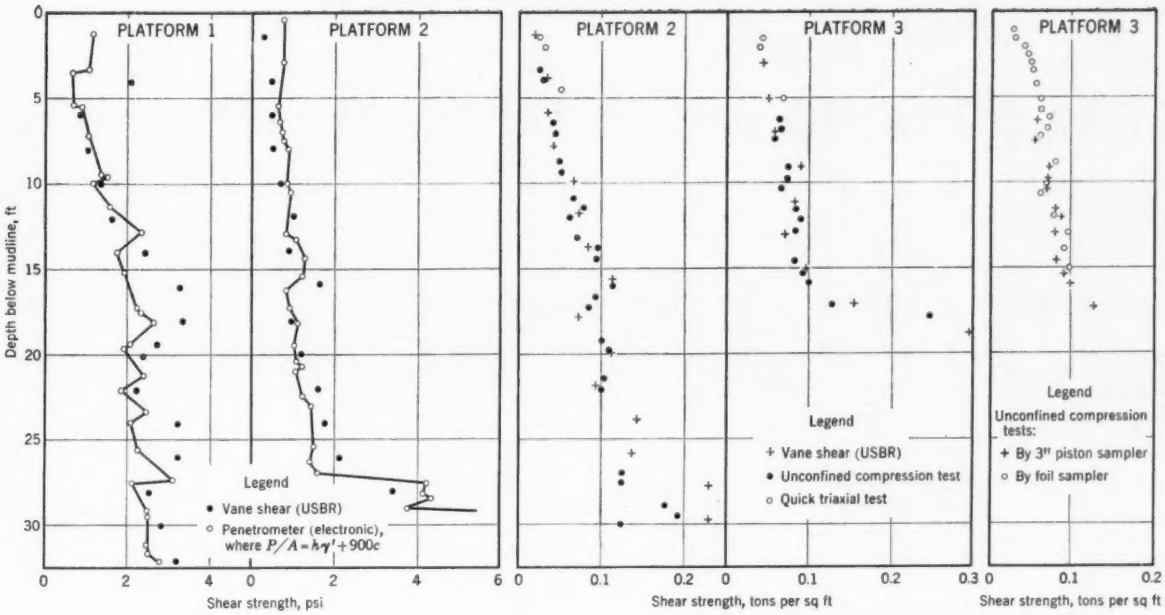


FIG. 2. Shear strengths of clay obtained by U. S. Bur. of Reclamation vane shear device are compared with those by penetrometer.

FIG. 3. Shear strengths of clay obtained by vane shear device are compared with the results of laboratory tests.

FIG. 4. Two sampling methods yield similar test results.

Extrusion is accomplished by pulling out the foils (and core) into a trough. A thin slice is then peeled off the core the entire length of the sample for purposes of soil classification.

The advantages of the foil sampler are obvious where a complete soil profile is desired. All strata, including void spaces, are disclosed to the soils technician at their exact depth below the ground surface. Permeable layers or hard crusts can also be accurately measured. Disturbed areas sometimes are found in soft layers immediately below a hard layer as a result of the resistance of the hard layer to the cutting edge. With the new samples, such disturbed material can be avoided for testing, and representative samples selected elsewhere.

The quality of the samples proved the feasibility of the sampler, and the number obtained provided its economic justification. No permanent towers were required for the foil-sampler operation as the sampling at each location required only a few hours' work. A portable pipe tripod, 35 ft high with two working decks, was built. After the sampler tower was attached, one continuous sample, 35 ft long, was obtained at each setup. The equipment used included a barge with A-frame and hoist, a tugboat, and the tripod.

Undoubtedly use of the piston-type sampler is economically justified for shallow holes where continuous samples are not required. The average rate, under the same conditions, for a shallow uncased hole using the Hvorslev piston sampler was 10 ft a day. The need for a drill rig to take deep samples increases the cost of conventional piston sampling. Laboratory tests of samples obtained by the use of the foil sampler are compared with those obtained with a piston sampler in Fig. 4.

The test data indicated very low bearing values for the clay soils. But, by removing some 25 ft of valueless mud by dredge and then placing a sand-and-gravel blanket 25 to 40 ft deep over a width of some 400 ft (Fig. 1), a center rock section could be put down that would support the railroad embankment. The fill is being constructed from both ends over clays of low bearing value toward a 5-mile center section which is underlain by the firm, deep bed of Glauber's salt. This will provide time for the fills at each end to consolidate the underlying clays. Little consolidation is expected under the salt layer, and a wide fill section is not necessary to prevent displacement in this area.

Foundation investigations at Great Salt Lake have been very successful in providing the engineer with the reliable information he needs for a safe and economical design. The foil sampler was found to be the most successful device used during the investigations to evaluate the strength characteristics of the clays. IECO's policy is to use engineers to supervise sampling. The foil sampler is regarded not as a contractor's drill machine, but as an engineer's tool of the same importance as the devices used to test and evaluate the sample itself.

Development of sampling technique progressed from the elementary to the technical. Special advisers and consultants were employed as follows. David Piertz, University of California, aided in the design of the electronic devices; and William Holtz, USBR, advised on vane shear testing techniques. Consultants for testing techniques and requirements were Dr. A. Casagrande, M. ASCE, Harvard University; Dr. F. H. Kellogg, M. ASCE, University of Mississippi; R. R. Philippe, Chief, Soils and Cryology Branch, Corps of Engineers; Stanley Wilson, A.M. ASCE, Shannon & Wilson, Seattle, Wash.; and T. Kallstenius, of the Swedish State Geotechnical Institute, one of the inventors of the foil sampler.

The men responsible for the design and construction of the rock fill were William M. Jaekle, M. ASCE, Chief Engineer, Southern Pacific Co., and C. P. Dunn, M. ASCE, President, International Engineering Co., Inc.

Great Salt Lake Crossing

$49,000,000 project for Southern Pacific

W. M. JAEKLE, M. ASCE Chief Engineer, Southern Pacific Company, San Francisco, Calif.

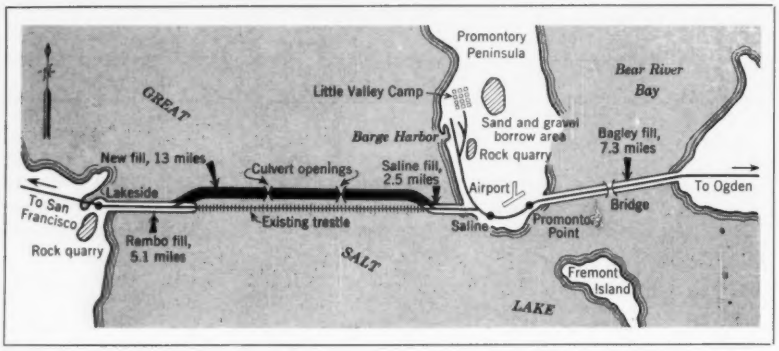


FIG. 1. In new crossing, three old fills are fully utilized. These are Bagley Fill, Saline Fill, and Rambo Fill, placed in 1902. All sand and gravel comes from one area on Promontory Peninsula. Rock comes also from westerly side of lake.

A mountain of material is being economically moved into Great Salt Lake to put the Southern Pacific Railroad crossing on a completely dependable roadbed. The project entails the dredging of 16 million cu yd of muck from the lake bottom and the dumping of 31.5 million cu yd of rock, sand and gravel. When completed in 1960, the new embankment will measure 12.68 miles long and will have an overall height of 70 to 75 ft and a width of 38 ft at the top and up to 400 ft at the bottom.

All forms of modern earth-moving equipment are used. First a 15-in. and an 18-in. hydraulic dredge take out soft and weak lake-bottom sediments along the line of the new fill. Electric shovels of 8-cu yd capacity load mixed sand and gravel on 27-cu yd bottom-dump trucks. These trucks feed the world's greatest (in terms of tons per hour) belt conveyor to deliver up to 4,200 tons per hour to storage. In a separate operation, additional big shovels load trucks that transfer rock to bottom-dump and flat-deck scows or haul direct to the core of the fill. These are supplemented by side-dump rail cars working from the westerly shore of the lake.

Great Salt Lake, which covers a 2,000-sq mile corner of northern Utah, has long been an obstacle to transportation. In frontier days, wagon trains took a long, tortuous detour to the north. When the rails of the first transcontinental railroad moved closer to a junction from east and west, its builders elected in 1869, to veer north to finish the line rather than try any short cut across the soft clays comprising the bottom of the lake.

The Southern Pacific did tackle the job of crossing Great Salt Lake in 1902, some years after it had taken over the pioneer Central Pacific from San Francisco to Ogden. Under William Hood, M. ASCE, Chief Engineer of the Southern Pacific Co., railroad construction crews set out to build a rock fill as far as practicable across the two major northern arms of the lake. The easterly arm, Bear River Bay, was spanned only after considerable trouble. The exceedingly soft bottom between the west shore and the Promontory Peninsula forced builders to resort to a 12-mile wood-pile trestle to complete the crossing. This crossing shortened the line between Lucin, Nev., and Ogden, Utah, by 43 miles, eliminated 1,500 ft of adverse grades, and cut out 4,000 degrees of curvature.

Freight and passenger trains of the Southern Pacific have been operating across the lake since 1904. But while the lake was bridged, it always remained a problem.

Southern Pacific's present Great Salt Lake crossing project calls for construction of a new rock fill causeway across the deeper part of the lake, spanned now by trestle. The crossing utilizes all the existing embankment. The new fill is being built 1,500 ft north of the wooden structure to keep construction equipment from bumping into the old trestle and possibly interfering with train traffic. The new crossing will be nearly indestructible, which will greatly strengthen this transcontinental line—the Overland Route—as a defense artery.

Maintenance costs on the wooden

Harbor and material supply center for Great Salt Lake crossing are located on Promontory Point. Belt conveyor at upper right brings 4,200 tons per hour of sand and gravel to storage near waterfront. Barges secure rock from trucks loaded at principal quarry in foreground. Deck barges are loaded at dock at lower left. Ways where barges were assembled are at upper center, and pier for general service is on far side of basin.

trestle have been mounting steadily under heavier loadings, the wear and stress of the elements, and fifty years of use. To reduce impact and assure safety, trains have been restricted to "slow-order" speeds. Fire or possible sabotage has been an ever-present possibility for the wood structure. The unexpected vulnerability to fire of wood exposed to salt spray for years was demonstrated in May 1956, after work on the new fill was well under way. At that time, 645 ft of trestle was burned out in the first major fire in the history of the Salt Lake cutoff.

Planning for the new work has been under way since 1950. Actual construction started in June 1955, with the dumping of some fill material from railroad cars. Work was accelerated in March 1956 with the award of a $45-million contract to Morrison-Knudsen Co., Inc., of Boise, Idaho.

Installation of railroad track and signal equipment—to be done by Southern Pacific's own forces—will cost about $2 million. With such other expenditures as those for exploration, engineering, testing and overhead, the cost of the project will be about $49 million. However, all construction equipment, valued at $15 million, belongs to the Southern Pacific and will be sold or salvaged for other use.

A construction camp was established two miles north of Promontory Point, close to supplies of rock, sand, and gravel. Included are storehouses, workshops, dining hall, barracks, facilities for 300 family trailers, a supermarket, clothing store, restaurant, post office and school.

The first major job was the dredging of 1,000,000 cu yd of lake shore to build a half-mile-wide harbor and a channel to deep water 3 miles long and 15 ft deep. Docking and barge-loading facilities were installed by Ben C. Gerwick of San Francisco. A 44-kv power line was brought in from Ogden by Trowbridge & Flynn.

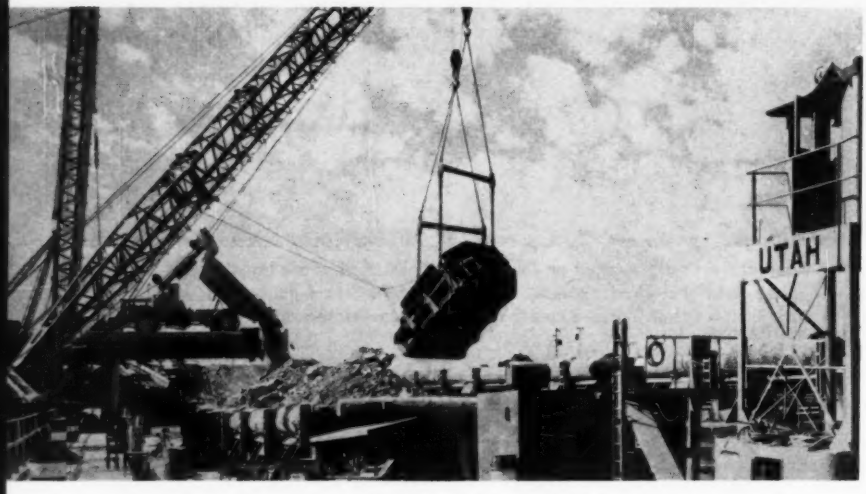
A pocket flotilla of barges, dredges, tugs, and workboats is bearing the brunt of fill construction. It is fed by an unusual aggregation of shovels and trucks, a major part of the material being moved by a most unusual belt conveyer.

All equipment is moved in by rail. Six of the largest bottom-dump barges ever constructed, each capable of holding 2,000 cu yd, were fabricated for the project by Kaiser Steel Co. These were shipped on railroad flatcars in 32 sections, weighing 10 to 30 tons each, for assembly at the site by Chicago Bridge & Iron Co. Five flat-deck barges were built by the Hammond Iron Works at Provo, Utah, to carry about 1,000 cu yd each.

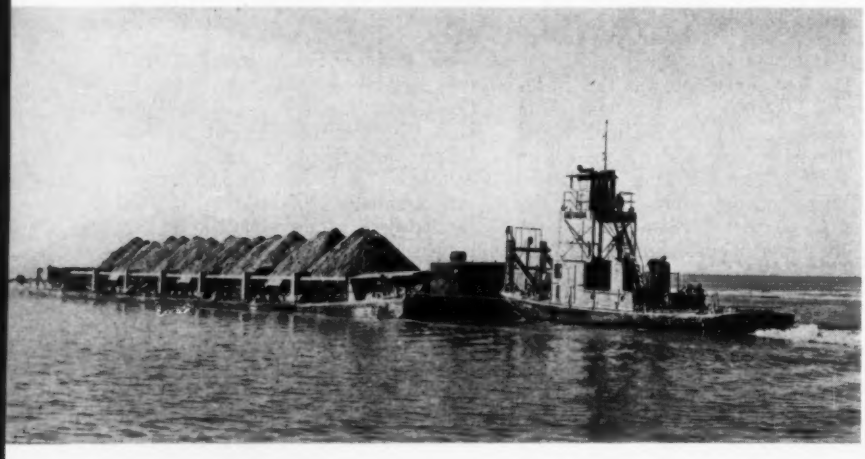
Six tugboats, each equipped with twin 500-hp engines, were built by Gunderson Engineering Co. at Portland, Ore., then halved down the centerline and moved by rail to Great Salt Lake for reassembly and launching. Additional 600-hp tugs handled the flat-deck barges while 300-hp tugs supplemented the larger vessels.

Material for the fill is of two kinds. Gravel, available at lower cost and better for contact with the soft clays, is used for the major part of the fill. Quarry-run crushed stone is used in the center section of the fill to best distribute the load with a minimum of settlement. Selected large rock from

At left: Stacker builds stockpile 70 ft high over two reclaiming tunnels. Stacker in turn is fed by conveyor 7,500 ft long, which delivers 4,500 tons of sand and gravel per hour.



Derrick in foreground places layer of rock over bottom-dump gates of barge ahead of general loading by dumping from trucks, seen under way in background.



Major part of $49 million crossing is underwater fill. Barge of 2,000-cu yd capacity has seven hoppers that can be dumped singly or together by remote control from tug.

the quarry is used for a blanket over the gravel fill and for riprap on the slopes.

Sand and gravel come from a range of hills some two miles from the lake and about 400 ft above it. Blasting is not necessary. Three 8-cu yd electric shovels load a fleet of 11 bottom-dump trucks for a short haul to a dumping station over the high-capacity belt conveyor. The sand and gravel, with plus 8-in. material scalped out and crushed, is loaded on the 54-in.-wide belt that travels at the unusual speed of 850 fpm. Accelerating belts, 30 ft long and 60 in. wide, operating at 500 fpm, reduce stress and wear at the loading point and at the one transfer point required. This "dog-leg" conveyor system carries the materials 7,500 ft to a radial stacker near the barge harbor. The main conveyor has a regenerative braking system that produces power as it controls the 400-ft downward component of material moving at the rate of 4,000 tons per hour. Electricity is fed into the job power system.

In a recent 30-day period, the belt delivered an average of 83,333 tons a day, with surges as high as 5,000 tons an hour.

The stacker at the waterfront is used to build a semicircular stock pile of 70,000-cu yd capacity over two tunnels made from Armco Multi-Plate pipe of 180-in. diameter. Each tunnel has five openings for reclaiming material. A 72-in.-wide conveyor in each tunnel delivers the gravel at a combined rate of 12,000 tons per hour, sufficient to load a barge of 2,000-cu yd capacity in fifteen minutes. When the material is moist, loading takes appreciably longer.

The crushed stone and riprap come from a quarry where very large blasts have been used. The largest was the detonation of 1.8 million lb of explosives at Little Valley on July 21, 1957. About 3 million tons of quartzite rock were obtained from this one blast. The stone is hauled by end-dump truck to the harbor, where it is loaded into bottom-dump barges or on flat-deck scows. The hopper barges are loaded by first lowering material in skip buckets to provide a cushion and then dumping from the dock.

Meanwhile in the lake, the 15-in. and 18-in. dredges have excavated a

trench in which the material is to be placed. A wide area is excavated and replaced with gravel fill, requiring some 400 to 500 cu yd per lin ft. Dredges work some 2,000 ft ahead of the fill operation, about the minimum distance permissible with equipment that can place as much as 50,000 cu yd per day.

The bottom-dump barges are positioned over the trench and dumped by remote control from the bridge of the tug. Each barge has seven hoppers that can be opened all together or individually. Profile of the underwater fill is checked daily, or after each dumping if necessary, by an electric fathometer mounted in a small boat. The bottom-dump barges have a draft of 11 ft so cannot be used when the fill comes within 12 to 15 ft of the surface. For this work the flat-deck barges are used; they are unloaded by tractors that push the material over the side. This procedure is supplemented by direct truck-haul operations at the east end of the project and by train haul with side-dump cars from the western end.

The fill is being placed from both ends toward the middle section founded on the rock salt formation. Two years are expected to elapse between completion of the end and mid-portions of the fill. There is much work yet to be done before trains can maintain full speed across Great Salt Lake. Unit costs of fill are given in Table I.

Technical phases of the operation are being handled by International Engineering Company under the direction of President C. W. Dunn and Chief Engineer T. Mundal, M. ASCE. H. V. Anderson, J. M. ASCE, has directed field sampling, testing and development of engineering data and design. Construction Division Engineer H. J. Willard and Engineer Inspector J. C. Strong, J. M. ASCE, have been active in coordinating the work of the contractor with that of the International Engineering Company for Southern Pacific.

Above: Rock is dumped down skids which are adjustable for height to prevent damage to flat-deck barge. Tractors shove rock off barge to build upper part of fill. Below: Work train of air-dump cars unloads rock at westerly end of fill project. Next, bulldozers will move in to push rock ahead and out over gravel blanket. Blanket was placed first, by bottom-dump barges, to within 12 to 15 ft of water surface, in trench provided by dredging.

Since 1904, Southern Pacific trains have passed over this 12-mile-long timber trestle on their way across Great Salt Lake. High salt content of lake water preserves the wood and damages iron fastenings less than would sea water.

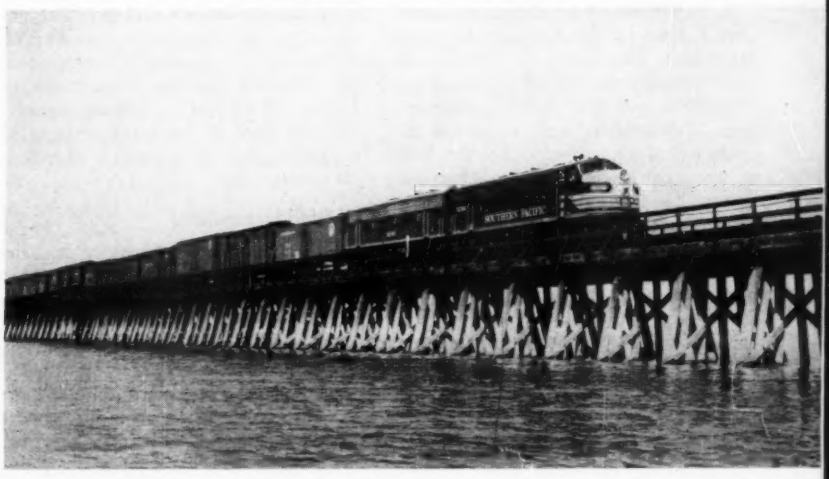


TABLE I. Unit cost of fill across Great Salt Lake

Operation cost only, not including purchase of equipment, plant installation, and overhead

ITEM	COST PER CU YD
Dredging	10.5 cents
Gravel fill by bottom-dump barge	39 cents
Rock fill by bottom-dump barge	75 cents
Rock fill by flat-deck barge	90 cents
Truck haul to fill, rock	90 cents
Train haul to fill, rock	67 cents

Cooperation among engineers builds New York Thruway

C. H. LANG, M. ASCE, Chief Engineer, New York State Thruway Authority, Albany, N. Y.

The impact of the accelerated highway program on the engineering profession makes necessary a harmonious relationship between engineers in private and public practice. That there has been some rivalry in the past between the two segments of the profession no one, I believe, will deny, but in New York State we have lived so long with consulting firms that they are now generally treated as full-fledged members of our official family. As such, they are expected to contend with a great many of the difficulties that formerly beset only the public official, including the completely frustrating task of trying to make one engineer do where three are needed.

Such family-type intimacy in our day-to-day affairs cannot but lead to a spirit of complete cooperation such as is found in all well-knit families despite occasional surface indications to the contrary. Certainly the New York State Thruway could not have progressed as rapidly as it did without the splendid cooperation and technical abilities of all the Thruway Authority consultants, headed by the greatest one of all, the New York State Department of Public Works.

A unique relationship

It may come as a surprise to many that I refer to the Department as a consultant. The Thruway Authority is unique compared with other authorities responsible for the design, construction, maintenance, and operation of modern toll expressways. To the best of my knowledge, no other turnpike agency has utilized the services of its state's regular employees in building its toll facility. The relationship between the Authority and the Department is so close and so unusual that it deserves a few words of explanation here.

The road now known as the New York State Thruway was conceived originally as a project of the State Department of Public Works. It was to be built as a free highway, and in fact several contracts were awarded by the Department on that basis. Because of the high cost of constructing such a completely new, all-purpose expressway, and because costs continued to follow the upward spiral of prices for labor and materials, it was soon evident that the Thruway would take too long to complete if financed out of legislative appropriations. Accordingly in 1950, the State Legislature created the Thruway Authority, with power to issue bonds for the required financing, and other powers necessary to administer the project. Design and construction then moved into high gear.

It was fortunate in those early days of the Authority that the post of chairman of the newly created agency and that of Superintendent of Public Works were held by the same man, Bertram D. Tallamy, M.ASCE. He it was who saw the wisdom of utilizing the wealth of experience and know-how of the engineers and staff of the Department of Public Works instead of creating a parallel organization in the Authority. In fact, because of his foresight, and the pursuit of the same cooperative policy by his successor (John W. Johnson, M.ASCE), the Authority's engineers comprise only the bare minimum needed to function in an administrative capacity. The engineering services needed for surveys, design, and supervision of construction are provided by the Department of Public Works and by private consultants. In spite of the acute drought of engineers, our construction therefore continues apace.

Divided into sections

To complete the Thruway in time to make it useful as an integrated cross-state expressway, it was determined early that the Department could not carry the load alone. The proposed facility was therefore divided into sections of appropriate length and the various sections were apportioned to different private engineering firms for design. The contracts for this work were usually divided into four main parts to cover survey, preliminary plans, final plans, and right-of-way maps. In general, route studies were not required as the route had been previously determined by the Department. In the few cases where minor deviations in location were necessary, the consultants' recommendations were carefully considered before the final determination was made.

Each contract agreement included a map showing the proposed route for that particular section of Thruway. A survey was then made by the consultant under the general direction of a District Engineer of the Department. On completion and acceptance of the survey, the consultant prepared a preliminary plan and profile of the highway together with suggested plans, profiles and cross sections of bridges. Approximate estimates were also made at that time. After a review and criticism of these preliminary data by several appropriate subdivisions of the Department, the consultant was authorized to proceed with the preparation of final plans, specifications and estimates. At the proper time during the development of the latter, he would also prepare the required maps for acquisition of right-of-way.

All this work was performed by the technical personnel of the consultant under the immediate direction of the engineers of the Department, with administrative and policy control in the hands of the Authority. In other words, the New York State Department of Public Works functioned and continues to function as the overall consultant for the New York State Thruway Authority, and in that capacity provides invaluable assistance. The need for cooperation in such a vast endeavor is obvious when it is realized that approximately 45 consulting firms contributed their services as well as the staffs of seven different district engineers of the Department, and main-office personnel in the Department's Bureaus of Bridges, Soils,

Rights-of-Way and Claims, Landscaping, Contracts and Accounts. The Laboratory also provided its expert services.

All these subdivisions of the Department continue to function when the project gets to the contract stage. Here again the consulting firm provides the engineers to man the job in the field, under the general technical supervision of Department personnel. The Authority continues as administrative head. In general, for supervision of construction, it is our policy to assign the same consultant who performed the original design. The reasons for this are obvious.

Equitable pay for engineering

At this point, it may be well to mention the arrangements for paying for engineering services. First, all services performed by engineers of the Department of Public Works for the Thruway project are paid for by the Authority. No tax money of the state is used for this purpose. Second, the design contracts with consultants all provide for payment of the fee on the basis of 3½ percent of the estimated cost of the project. To this is added a lump-sum fee to cover the survey (the amount depending on the character of the terrain) and a fixed sum per map for each right-of-way map.

Third, for construction services, the consultant is paid a fee of 4½ percent of the final cost of the project, exclusive of any awards for extras which the contractor may receive should court action be instituted. The final cost does however take into consideration any additions to or deletions from the original contract, if such changes have been duly approved by the Authority. Services for engineering supervision include stake-out of the project and maintenance of all precision controls. The criteria in this respect are the services performed by engineers of the Department of Public Works on similar projects.

Contracts for both engineering design and supervision of construction have generally worked out satisfactorily with a few notable exceptions. These should be mentioned in the hope that our experience will be of value to those responsible for executing similar contracts in the huge federal highway program now under way. The exceptions are three in number. Two apply to design contracts and one to contracts for supplying engineering services during construction.

First, our contracts for design stipulated a 3½-percent fee based on the estimated cost of the project at current prices. On completion of the plans, specifications, and quantity estimates, a serious disagreement arose as to the method of determining current prices. The Department practice is to assign unit prices to the various quantities based on past experience, supplemented by analyses of probable costs in the various areas of the state. In most cases the consultants concurred in the estimates approved by the Department and the Authority, but in a few cases they made strong objections.

The most controversial item, as might have been expected, was excavation. Prices differed widely as earth or rock was anticipated, depending also on its geographical location. Many of our Thruway and Department engineers could see no justice in allowing one consultant a fee based on a price of $10 per cu yd for rock excavation when his neighbor was unlucky enough to encounter excavation at $1 per cu yd. Certainly the engineering involved in the one project could not be considered worth ten times the other.

Second, our contracts stipulated a fixed fee for each map made for the purpose of securing a parcel or parcels of right-of-way. Again, as might have been expected, the fee was not too far out of line when rural maps were the rule. In urban sections, however, the consultant often found himself in the unenviable position of spending many times his anticipated fee in completing maps and descriptions of parcels of urban property.

Third, in our original contracts for construction supervision, the 4½ percent fee could not be augmented if the contract completion date was not met. This meant that engineers received the same payment if the work took two years (as may have been required in the construction contract) or if an additional year was needed by the contractor. Because of delays due to bad weather, material and labor shortages, and labor disputes, it was the rule rather than the exception that the contracts went over the original completion date, with consequent vehement protests by some consultants.

All the foregoing points at issue can be satisfactorily resolved in the contract provisions. I would strongly recommend that the basis of fee payment for design and right-of-way maps be so spelled out that there is no possibility of differences in interpretation. For construction supervision, the contracts should contain a formula to compensate the consultant for extended residency made necessary by events beyond his control.

Beyond the obvious area of service of the consultant to public agencies, there lies another area in which he is of special value. Much as we hate to admit it, the breast of the average citizen seems to harbor a strong feeling that public agencies have been created to oppress him, and that such oppression stems both from incompetency and from lack of understanding. The same citizen who accepts without question a ruling of the doctors in a public health agency or the pronouncements of a legally constituted court, screams to high heaven that the engineers of an authority or commission or state highway department don't know what they are about. Knowing this, we find it very effective to use our consultants as experts to refute the arguments of amateur engineers who quite frequently are not at all impressed by the same arguments when presented by Authority officials.

Just as the private engineering firm is valuable to us as a consultant in the type of controversy just mentioned, so the Department of Public Works is valuable as a general consultant in other directions. For example, in building the Thruway, it was necessary to reach agreements with the various political subdivisions through which the expressway passes. Crossroads of towns, counties, and cities were affected, and through the good offices and experience of the Department, the necessary adjustments were accomplished with a minimum of disturbance to the local scene. The same thing was true where railroads were involved, as the Authority utilized to the fullest extent the Department's ability and experience in effecting satisfactory and economical solutions to the problems that arose in this field.

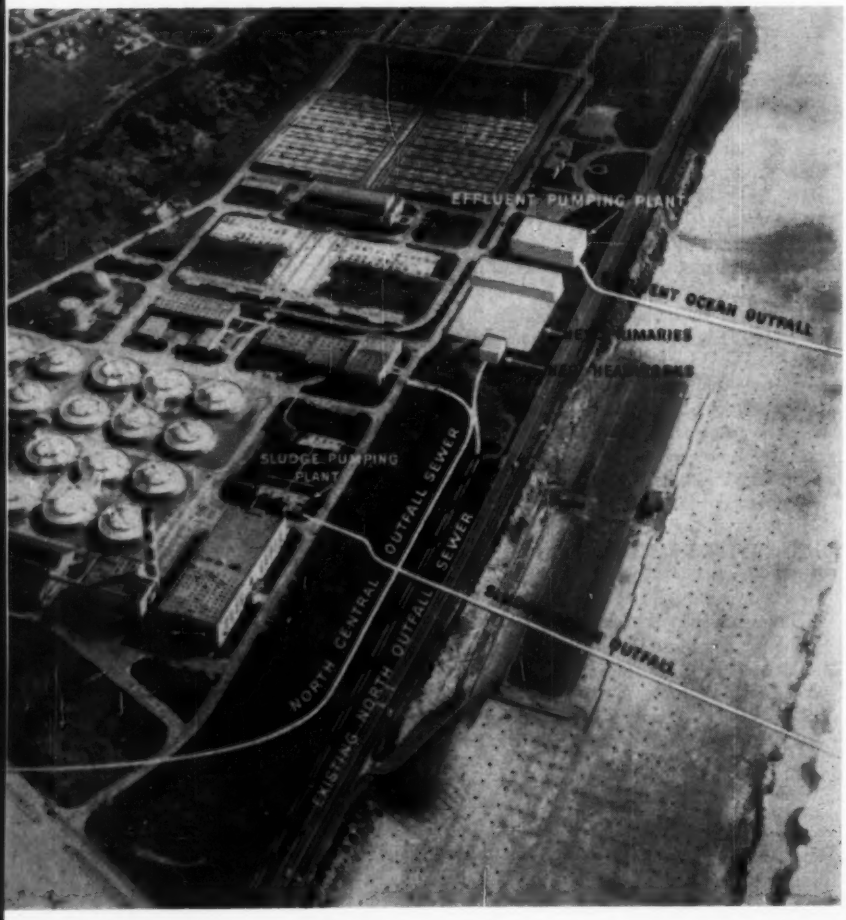
Cooperation is more than a word

From all this it can be seen that in building the greatest highway system known to man, cooperation will have to be more than a five-syllable word. Every ounce of cooperative ability of every engineer engaged in the federal highway program will be needed to accomplish the work that lies ahead. Engineering is a profession that depends upon the smooth functioning of a team in order that ideas may first be transmitted to paper and then converted into finished work. Engineers have been working together for the general good ever since the beginnings of human endeavor. It is inconceivable that they should ever fail to find strength in united effort.

(This article is based on the paper presented by Mr. Lang at the ASCE Buffalo Convention, before the Highway Division session presided over by Archie N. Carter, a member of the Division's Executive Committee.)

Hyperion Plant expanded

Large increases in population, and consequently in quantity of sewage to be handled, have made it necessary for Los Angeles to provide a corresponding increase in the capacity of its sewerage and treatment system. In their article in the November issue, the authors described the new land outfall, eight miles long and mostly in tunnel, with a capacity of 354 cfs when flowing three-fourths full. This outfall feeds into the Hyperion Treatment Plant, which of course had to be expanded to handle the increased load, as here described. The third and final article in the series will explain the design and construction of the two ocean outfalls which complete the present program. The sludge-disposal outfall, 7 miles long and of 20-in. diameter, is already completed. It will discharge into an under-water canyon where the water is 320 ft deep. The effluent outfall, 5 miles long and 12 ft in diameter, when completed will terminate in water 190 ft deep.



Major new construction required at the Hyperion Sewage Treatment Plant under the Citizens' Committee Program consists of a pumping station to discharge digested sludge to sea, a new headworks building to house additional screening equipment, a new grit removal facility, and a bank of new primary settling tanks. These items, shown on the accompanying aerial view of the plant, will increase its capacity from an average flow of 245 mgd to 420 mgd. In addition, it was necessary to design an effluent pumping station capable of discharging the future storm flow of 720 mgd through the 5-mile-long ocean outfall. The available head is insufficient to move such flows by gravity.

Under future flow conditions the existing primary settling tanks, if not expanded, would have to operate at a rate of 3,100 gal per day per sq ft of area. Since the tanks were originally designed for an overflow rate of only 1,800 gal per day per sq ft, it was deemed advisable to check their operation closely under conditions of increased flow.

The extensive settling experiments showed that under present conditions the Hyperion primary tanks reduce the settleable solids from 12 ml per liter to less than 1 ml per liter at a flow of approximately 2,000 gal per day per sq ft. One of the tanks was modified during the experiment and excessive

Hyperion Sewage Treatment Plant is being expanded by addition of two pumping plants (for new effluent and sludge ocean outfalls), a headworks building to house added screening equipment, new grit-removal facilities, and a bank of primary settling tanks. Construction of the two ocean outfalls will be discussed in a forthcoming article.

to treat 420 mgd

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amounts of flow were forced through. It was determined that about 3 or 4 ml per liter of settleable solids remained in the primary effluent from this tank when it performed at a rate of 3,100 gal per day per sq ft. Since an additional 2 or 3 ml per liter of settleable solids in the primary effluent would not be acceptable under future conditions, it was decided to add a new battery of primary settling tanks.

The new battery will increase the primary settling capacity by 50 percent and produce an average overflow rate at design flow of 2,100 gal per day per sq ft. The new primary tanks will have a concrete slab over them, as has been the policy at Hyperion. In addition, the effluent end of the tanks will be enclosed in a building that will also house the scum removal equipment and weirs.

Each individual weir will be 50 ft long, and the total weir length will be such that the average overflow rate will be about 60,000 gal per day per lin ft. The higher loading was selected after extensive experiments at the Hyperion Plant. These experiments were performed in conjunction with the determination of settleable solids reduction previously described. It was found that equally good results were obtained with loading rates of 70,000 and 40,000 gal per day per lin ft, and the weir lengths were reduced accordingly.

Scum will be removed from the new primary tanks by means of flights up to the scum barrier, and then by water sprays in the weir area itself. The weirs are longitudinal in alignment so that any scum which passes the barrier can be collected by the water sprays and driven to the scum trough, where it will be picked up by a rotary-type skimmer. The average depth, at a loading rate of 60,000 gal per day per lin ft of weir, will be about one inch.

As previously indicated, modifications to the Hyperion Treatment Plant provide for 120 mgd of standard-rate activated sludge effluent. This water can be used for industrial purposes, for irrigation of the plant grounds, or for recharge of the underground basin if it proves desirable. Chemical analyses of the incoming raw sewage showed that the major problem in reclaiming the secondary effluent was removal of the chlorides present in Los Angeles sewage. The bulk of these chlorides are derived from the coastal areas near Venice and Santa Monica. Since high salinities cannot be successfully removed, it was essential that sewage from the coastal areas be kept out of the secondary portion of the plant.

To facilitate separation of sewage with a high chloride content from the more normal sewage a complex flow interchange structure was designed. This structure is to direct the flow from the Venice and Santa Monica areas into the new headworks and primary-settling-tank system, thus bypassing the secondary treatment system. A model of the proposed interchange structure, constructed on a scale of 1:20, was operated by the California Institute of Technology. This model demonstrated that the hydraulic characteristics of the interchange structure would be satisfactory and showed conclusively that it could accomplish its purpose of separating the saline and non-saline waters.

Approximately 10 mgd of secondary treated effluent will be used on the plant grounds for lawn watering and other industrial purposes. Any excess effluent can be disposed of through the ocean outfall or utilized for other purposes if found advisable.

Odors plague operators of sewage treatment plants throughout the world and, although Hyperion is relatively free from this problem, there have been some complaints from the neighboring City of El Segundo. The existing plant is extensively ventilated and the foul air is at present disposed of either by discharge from the tops of buildings or by transfer to the large stack.

Experiments were conducted at the Hyperion Plant to determine whether foul ventilation air could be used as make-up for the blowers supplying the activated sludge tanks. The tests were made by constructing a small activated sludge tank and passing air, both clean and foul, through the tank. Samples were collected and tests made to determine the extent and persistency of odors. These experiments showed that foul air passed through mixed liquor in activated sludge tanks will have no more odor when it emerges than clean air that has been similarly passed through the activated sludge. Since the results of these tests were favorable the entire new primary settling system and the North Central Outfall Sewer, calling for a total of 112,000 cfm of air, will be ventilated and the foul air will be conducted to the make-up plenum and introduced into the five existing 40,000-cfm blowers supplying the activated-sludge mixed-liquor tanks.

The work described was awarded to a joint venture of Peter Kiewit Son's Co. and the Fred J. Early Co. for $4,020,579. Another contract for about a million dollars worth of modifications to existing equipment is still to be awarded. These additional modifications will reduce maintenance costs at the plant.

Effluent pumping plant

One of the major facilities in the expanded Hyperion Plant will be the effluent pumping plant, one of the largest structures ever designed to handle primary treated sewage effluent. The pumping station will handle a dry-weather peak flow of 600 mgd and can be expanded to accommodate the anticipated storm flow of 720 mgd if justified.

Careful investigation was made to determine the type of pumping unit to

be used. Four types of pumps were investigated—horizontal centrifugal, vertical wet-pit, propeller type, and vertical dry-pit. Horizontal pumps were discarded because of their space requirements and flooding danger. Wet-pit pumps were discarded because of their poor maintenance features and difficult flow entry characteristics. Variable-pitch propeller pumps were discarded because of their sketchy experience record with sewage. Vertical dry-pit pumps were selected since they most nearly fill all the requirements.

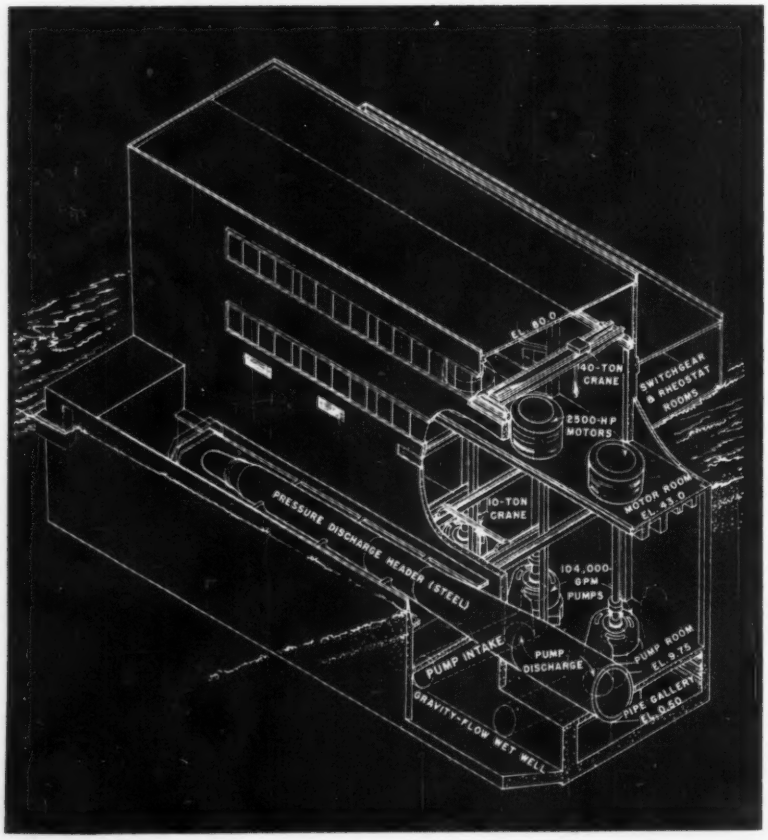
There will be five pumps in the station with space for a future sixth unit. Three of these pumps will be of variable speed, driven by wound-rotor motors. Two will be driven by synchronous motors. It is essential that some of the pumps have speed control because all head is developed from friction, and operation will vary from zero to about 100 ft of head depending on the rate of flow. Each pump will be rated at 2,500 hp and will operate at a speed of 315 rpm. During many hours of the day the entire flow from the plant will pass, by gravity, through the long ocean outfall since the characteristics of this pipeline allow approximately 300 mgd to flow without pumping. However, some pumping will be required each day to accommodate peaks.

The pump station itself will be entirely automatic. As the flow increases, the pump motors will be started by meters at the entrance to the treatment plant. As the water level in the wet well rises, the pump discharge valves will open and the gravity-flow valve will close. Essentially all valves in the effluent pumping station will be of the butterfly type. They will be operated by electric motors except the gravity-flow valve, which will operate hydraulically. The variable-speed motors will also be controlled by the water level in the wet well.

Power for driving the effluent pumps is provided by existing gas-engine-driven generators and also by a new external connection to the city electrical system. This outside source is required because there is insufficient existing generator capacity at Hyperion to pump peak flows. The dual source will insure an uninterrupted supply of power.

The pump station will be enclosed in a building 171 ft long, 74 ft wide and 80 ft high. The wet well is protected with a vinyl-plastic, corrosion-resistent liner in parts that are not continuously submerged. It is anticipated that the construction contract for this facility will be awarded during January 1958 at an estimated cost of $3,700,000.

Effluent Pumping Plant, one of largest structures ever designed to handle primary-treated sewage, will have capacity of 720 mgd. Schematic cutaway sketch shows general arrangement of structure estimated to cost $3,700,000. It will contain five pumps, with space for future sixth unit, and will be 74 X 171 ft in plan at motor-floor elevation.



Sludge pumping plant

To eliminate fertilizer production if it continues to be economically unsound, an ocean outfall of 20-in. I.D. and an appurtenant pumping station are being provided so that the inert sludge can be discharged into Santa Monica Bay. The existing system delivers digested sludge to the filter and dryer building, where it is converted into commercial fertilizer. To hold down construction costs and to keep disruption of plant operations to a minimum, the existing facilities are being modified so that sludge can be disposed of either by pumping directly to sea through the ocean outfall or by discharge to the filter and dryer building to produce commercial fertilizer.

Long-distance pumping of sludge was extensively investigated. The most important single factor was found to be to maintain the solids in such a state that their hydraulic characteristics are similar to those of water. The new station has been so designed that the digested sludge, containing from 3 to 4 percent of solids, will be diluted with about twice its volume of secondary effluent before disposal in the ocean. The sludge can be pumped out continuously, with the addition of the proper amount of plant effluent, or it can be stored in an existing elutriation tank and pumped out intermittently.

Evidence indicates that it will be advisable to keep the flow continuous and relatively constant whether it consists of sludge plus dilution water or entirely of dilution water. The system will accommodate an ultimate flow of 2.5 mgd of sludge. To minimize clogging and build-up of sediment in the outfall, a flow of 5.5 mgd will be maintained through it. The proportioning of sludge and dilution water is automatic and insures that the desired flow will prevail at all times. Provisions have been made for the insertion of a cleaning device into the ocean outfall.

The sludge pumping plant was constructed by a joint venture of Hoagland-Findlay Engineering Co. and Kemper Construction Co. for $87,360.

Registration . . .

first step toward professional recognition

NEWELL L. FREEMAN

Secretary, New York State Board of Examiners for Professional Engineers and Land Surveyors, Albany, N. Y.

Registration should be, not the terminal point, but the starting point or almost the starting point of a professional career. It is an important step in a series of steps that lead up to professional recognition.

Perhaps the engineering registration laws that appeared in this country for the first time early in the twentieth century were shaped somewhat by atavistic influences. Four thousand years ago, the first code of laws contained regulations concerning the construction of buildings and penalties for deaths that might result from a structural failure. As the late William E. Wickenden, President of Case School of Applied Science, in *The Second Mile* (published by ECPD, 1941) pointed out, the medieval Hanseatic League and the London guilds were direct ancestors of the present-day professions of engineering and architecture.

Civil engineers and the American Society of Civil Engineers were true pioneers. All branches of the engineering profession are indebted to them. The name "civil engineer" was coined when it became necessary to distinguish between military engineering and civil engineering, which became the first important branch in the engineering profession. It set up the first of the many engineering societies and was the first to encounter the problem of incompetent practice.

Wickenden pointed out that there are individual professions like painting and group professions such as law, where the membership constitutes "the bar." There are open professions like music, to which anyone may aspire within the limits of his ability, and closed professions such as medicine and engineering. When the safety of life, health or property becomes important, it is customary to regulate by law the professional practice in a particular area, and a profession so regulated is said to be "closed." This is primarily for the protection of the public.

There are four viewpoints as to what constitutes professional life, according to Wickenden. It may be called an attitude of mind, a kind of work, an order of society, or a fiduciary relationship between client and practitioner. In a measure, a true professional man has all of these viewpoints.

Speaking on "The Philosophy of Professional Licensure" (published by NCSBEE, 1937) before the Thirtieth Annual Congress on Medical Education, Licensure and Hospitals in Chicago, in 1934, Justin Miller, Dean of the Duke University Law School, stated:

"It is said that in former ages the general level of intelligence was so low that lay people were actually at the mercy of members of the learned professions. Today, though the general level of intelligence has moved up appreciably, the content of knowledge in the professions has, perhaps, increased even more greatly. It is a matter of necessity, therefore, not of choice, that the control of licensure is delegated to members of each profession. No one else knows enough about the science and the art involved in each case to insure to those outside the profession the benefits thereof on the one hand, and protection from spoliation on the other."

The major obligation of a profession is to serve and protect the public. Again quoting Miller:

"One way of testing the nature and extent of that obligation is to consider the difference between a profession and a business. In business transactions each participant is assumed to be equally well informed and equally able to hold his own in the give and take of trade and barter. The well known maxim of the law warns: 'Let the buyer beware.' On the other hand, a member of a profession is assumed to be better informed than the client or patient whom he serves, and stands in the position of champion or protector."

A 1954 statement of the Board of Directors of the American Society of Civil Engineers contained the following:

"The professional engineer should act for his client in professional matters as a faithful agent, giving to each problem to the best of his ability the benefits of his training, experience, and judgment. For such services, the engineer should ask and receive adequate compensation. Such standards of service cannot be rendered if the engineer offers to do the work for less than an adequate fee or for less than cost."

Thus the pattern is established. In return for what is the equivalent of a franchise, the public expects, as it should, competence, ethical performance and protection from bungling and extortion.

Returning to Wickenden, there are six attributes possessed by a true professional group. In descending order of importance, they are: (1) technical knowledge and skill, (2) a required educational process, (3) a standard of qualification, (4) a standard of conduct, (5) formal recognition of status, and (6) a professional organization concerned with common advancement and social duty. The primary importance of the first is unquestioned. On the other hand, the basic importance of the professional organization, the sixth, is almost as great. Preceding it is "formal recognition of professional status," which is registration.

Recognition in and by the profession, obviously, is not likely to precede legal recognition. Registration finally has become fashionable and now is generally regarded as necessary and proper.

(This article is taken from the address Mr. Freeman delivered at the ASCE Buffalo Convention, before the session presided over by Glenn W. Holcomb, Chairman of the Society's Dept. of Conditions of Practice, with David G. Baillie, Jr., Chairman of the Committee on Registration of Engineers, as Moderator.)

Aqueduct Claudia, of 52 A.D., marked a return to the massive cut-stone masonry of earlier days. Called "most magnificent" by Frontinus, it carried water 9¼ miles across the lower Campagna on massive stone arches to Rome. Many sections of it still stand.

The Architectus of the Roman Empire—Part 3

J. K. FINCH, M. ASCE, Dean Emeritus and Renwick Professor of Civil Engineering, Columbia University, New York, N. Y.

The Golden Age of Augustus, which was responsible for so many notable engineering works both in Rome and in the provinces, came to an end with the death of the Emperor, in 14 A.D. Augustus was followed by his stepson Tiberius, an able soldier, strict economist, and experienced man of affairs. However, he was intolerant of others and his private misfortunes embittered his life. In 37 A.D. he was succeeded by Caligula, a young man who, sunk in dissipation and crazed by great power, was killed by his own officers after a reign of only four years. The next emperor was Claudius. It is said that the imperial guards found this nephew of Tiberius hiding in the palace and made him emperor.

We shall probably never know the full truth regarding Claudius. He has been described as weak in mind and body, a mere figurehead, but also as a shrewd and crafty opportunist who posed as a half-wit and deliberately encouraged such fictions in order to maintain his uncertain and precarious position. It seems clear, however, that in his thirteen years of rule (41-54 A.D.) he accomplished much for the Empire and devoted such abilities as he had to its affairs. He conducted in person a successful campaign in Britain, was active in public improvements, and seems to have taken a genuine interest in some of the greatest engineering works of Roman times.

The officials he gathered round him are likewise said to have been grasping and unscrupulous but they clearly formed an able cabinet of efficient ministers. They were largely Greek freedmen and one in particular, Narcissus, appears to have been his "chief of works." Unhappily Claudius was unable to meet the hazards of his position and was probably murdered. The complex affairs of the Roman Empire went from bad to worse after 54 A.D., as one weak or puppet emperor followed another.

Frontinus characterizes one of the great works of Claudius, the Claudian Aqueduct, as "opus magnificentissime consummatum." While it followed the alignment established by Marcia, around the hills from Tivoli, Herschel observes that the difference in length between Marcia (58 miles) and Claudia (43 miles) is the difference between a timid alignment that followed supporting ground up and around side valleys, and a bold and skillful line surveyed and leveled to save distance.

Claudia also marked a temporary abandonment of the cheaper brick and concrete and a return to the old and solid cut-stone of earlier days. No less than 9¼ miles of the conduit were carried on massive cut-stone arches the impressive ruins of which still stand today. Another aqueduct, Anio Novus, begun under Caligula in 38 A.D., was completed by Claudius, who carried it across the Campagna piggy-back on top of the arches of Claudia.

Water carried by the Aqueduct Claudia reached Rome in 52 A.D. At that time, Herschel estimates, Rome was supplied with about 38 gal per capita per day, more than is provided in the majority of European cities even today. Only 20 years later Claudia, in spite of its apparent solidity, had to be restored by Vespasian, and again 10 years later, by Titus.

Largest tunnel of ancient times

A second great work of the reign of Claudius involved the largest tunneling undertaking of ancient times, the drainage of Lake Fucinus. This project recalls the uncompleted efforts of the Greek tunnel expert, Crates, to drain Lake Copias, north of Athens, some three or four centuries earlier. Like Lake Copias, the Italian lake occupied a land-locked basin, was subject to wide variations in level, and frequently submerged crops planted on its fertile shores. The problem of food supply had long been critical in Italy. The corn dole had appeared during the late Republic. Augustus had given

special attention to cleaning out the ditches and rehabilitating the irrigation facilities of Egypt, which became the granary of the ancient world. The Lake Fucinus project was thus primarily dictated by agricultural needs.

This project involved driving a tunnel 3½ miles long under Mount Salviano and the Palentine Plains to provide an outlet for the lake in the River Liris. Three-quarters of the work was in compact limestone but two long sections, under the plains and at the great depth of 328 ft, were in earth. Suetonius states that 30,000 men were employed 11 years on this great task. Pliny the Elder, who actually saw the work in progress, said it was such an extraordinary undertaking that words could give no idea of the labors involved.

There were two slight bends in the tunnel alignment, evidently to reduce the depth to which the many intermediate shafts had to be sunk. In fact the many *putei* (vertical shafts) and *cuniculi* (inclined shafts or adits, literally "rabbit holes") are the most amazing features of the work. They afforded easy access for men and materials, provided ventilation, and increased the number of working headings. Their total length is almost twice that of the tunnel itself. Clearly this expedited the work but one wonders whether "made work" might not also have been a consideration in their use.

Unfortunately it is not at all clear how successful this formidable undertaking was in accomplishing its purpose. Its completion was marked, it is recorded, by a great mock naval battle on the lake in which 19,000 convicts took part. Another celebration appears to have been held when new inlet works were provided. A modern tunnel, built by Prince Torlonia in 1854-1876, successfully drained the lake. It followed the old alignment and thus revealed the ancient work, which was found to have been uneven in quality. (See *The Drainage of Lake Fucinus* by Alex. Brisse and L. de Rotru, Rome, 1876, in French and English.) The old tunnel varied in section; in earth it was partly lined with stone or brick while other sections were roughly timbered. Mistakes in the alignment of the headings and their connection by offsets were also noted. More important, the grade was far from uniform and the inlet was hardly low enough to do more than reduce the higher lake levels.

Rivers and harbors

Looking at the Rome of today, it is difficult to picture the busy river boats that once served the city, or to visualize the great harbor and transshipping center at its famous port of Ostia at the mouth of the Tiber. The silting of the river has left Ostia miles inland, and the ancient docking levels at Rome have long since been replaced by channel walls. It is said that at one time the broken remains of the great earthen jars used in shipping food to Rome formed a mound over a half mile around and 100 ft high—Mount Testaccio, at the lower end of the city.

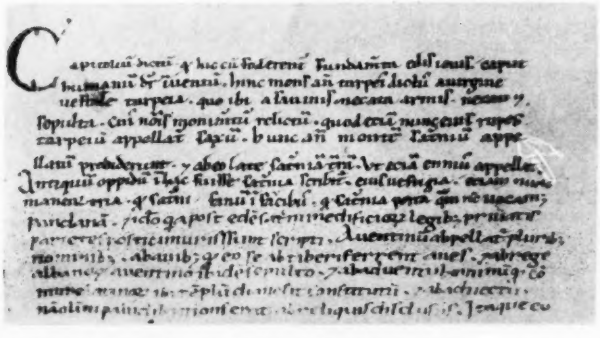
The harbor at Ostia, built under Claudius, generally followed the Greek plan with enclosing breakwaters. This important port was connected with Rome by two roads as well as by the River Tiber. One can imagine the busy docks equipped with treadmill cranes unloading the products of the Roman world. Later Trajan added to the facilities at Ostia. As has often been remarked, it was not by accident that the great cities of the world were located on navigable streams. Indeed until the advent of the railroad, water transport was supreme. Rome built harbors to meet her needs not only in Italy but in all her conquered lands.

The terrain surrounding Rome, especially that between Rome and Ostia, had early posed another problem. There are over 130 records of high flood levels of the Tiber at Rome. For example, the flood of 1598 reached a height of 42 ft above ordinary river level. The streams crossing the lower part of the Campagna, the relatively flat area 40 miles long and 30 miles wide between the mountains and the sea, have been subject to silting for ages. As early as 200 B.C. this raised a problem for Rome, which is centrally located in this flat area. Livy, the famous historian of the Augustan Age, attributed Rome's greatness to the qualities of the land on which it was built. Apparently much was done under Augustus to drain these marshy areas and to develop farms, villas, parks, and estates. But although the details are far from clear, it is evident that neglect allowed this territory to again become desolate and malarious, a home for mosquitos and brigands. In fact it remained in this condition until the early nineteenth century. South of Rome the Pontine marshes posed a similar problem which also received attention under Augustus, inspired no doubt by the agricultural shortages of the day. Only in recent years have these drainage problems been adequately solved.

Few great engineering works were undertaken between the death of Claudius and the reigns of Trajan and Hadrian, which marked the final great period of the Roman Empire. However, a number of notable buildings were erected in this interval, including the Colosseum or Flavian Amphitheater at Rome. This great structure, completed under Titus in 80 A.D., was the scene of the cruel shows and combats by means of which Rome's rulers attempted to quell unrest and purchase public support. It has been said that "this wonderful structure, which can only be compared to the pyramids of Egypt, is perhaps the most striking monument at once of the material glory and of the moral degradation of Rome under the Empire." Then, during the quiet but brief reign of Nerva (96-98 A.D.), a major engineering figure appears. Frontinus was appointed director of the water supply of Rome in 97 A.D.

Frontinus and his book

Engineering owes a great debt to one of the most colorful and perhaps



Earliest known manuscript of Frontinus' "De aquis urbis Romae," of which this is from last page, was discovered by Poggio about 1400 A.D. at Monte Cassino in Italy. Frontinus asks, "Will anybody compare the idle Pyramids, or those other useless though much more renowned works of the Greeks with these aqueducts, with these many indispensable structures?"

also one of the most annoying of the early Renaissance "humanists," the papal secretary Poggio (1380-1459). In his position he had access to monastic treasures, and it was he who unearthed both the manuscript of Vitruvius at St. Gall in Switzerland and that of Frontinus at Monte Cassino south of Rome. The latter was called *De aquis urbis Romae*, "On the waters of the City of Rome." The pioneer American hydraulic engineer and inventor of the Venturi meter, the late Clemens Herschel, a Past-President of ASCE, translated this work (Boston, Dana Estes & Co., 1899) and added to it many illuminating notes and comments.

Only fragments exist of other works by Frontinus, who also wrote on farming, surveying, and the art of war. His career as a military man and a public official, governor of Britain, and twice consul, has been noted. His major work reveals the thoroughness, honesty, and competence of a public official of outstanding ability and sterling character.

Frontinus began his administration with a study of the history of the aqueducts. He inspected them and had plans of them made for, as he said, "In this way we reap the advantage of having, as it were, the works directly before us, and of being able to study them as though we stood beside them." Next to the historical notes, one of the most interesting parts of his report deals with what was probably the first water-waste survey ever made. Frontinus undertook to measure the flow of the main aqueducts and to check this against the water used within the walls of the city. His studies brought to light gross abuses in the unauthorized diversion of water, frauds practiced by "the water men" and loss and waste due to official negligence.

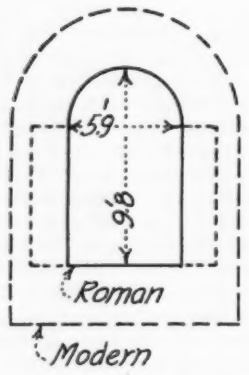
His was a fearless reform administration. He set about uncovering and digging up some of the 10,000 special branches of lead pipe that had been taking more than the overflow, or "lapsed water," from the public fountains. This privilege was subject to private grant but had been abused by "all who had been able to arrange for it."

Repairs were made in the ten existing aqueducts (Trajana had not yet been built), and leaks were patched up. After these reforms Frontinus estimated that the supply was almost doubled which, he notes, "was practically equivalent to finding new sources of supply." The pressure for an increased supply is understandable when it is recalled that in addition to some 250 delivery tanks distributing water for public use, there were also the public baths, and the private users of lapsed water. Also, the inflow was reduced by maintenance problems, which often kept two or three aqueducts at a time out of use for repairs.

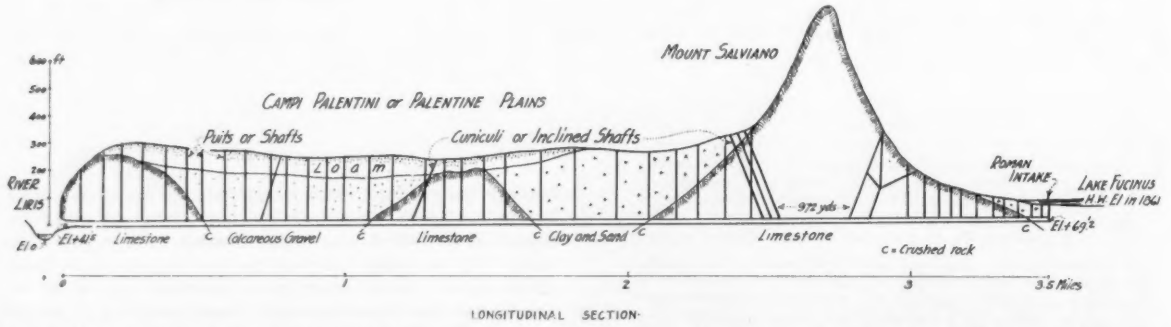
The ideas of the time on stream flow revealed in this study show that the Romans, in spite of their interest in hydraulics, had never solved the problem of water measurement. Frontinus simply checked the cross-sectional area of the aqueducts against that of the outlets in the city. A short lead pipe, or *adjutage*, of specified diameter and officially stamped, was the standard water meter. The unit of flow, the *quinaria*, thus neglected velocity and measured flow solely by area. Frontinus himself seems to have recognized that this led to difficulties and seems to have been on the verge of discovering the truth. He noted that care must be taken to set the outlet pipes all at the same level, not one higher and another lower in the tank wall. Also, they must be at right angles to the direction of flow for, if set facing the current, "they will take up more than their due measure." Similarly he observed that the flow from a high point through a short pipe "yields a surplus" while that from a low source through a long pipe "shrinks from its measure."

Water laws, the condemnation of land for construction, the right of eminent domain, fines for polluting the supply—are all discussed in this remarkable work. Frontinus took no half measures. He raised the standards of efficiency of the entire water works organization from the water gangs, reservoir keepers, line walkers and repair man to the overseers. As he states, he was "resolved to bring them back to some discipline and to the service of the state." It would be hard to find in the history of the profession a better example of the ideal engineering administrator of high purpose and outstanding ability than this justly famous Roman public official of the early days of the Christian Era.

(Subsequent articles will continue the story of engineering construction during the Roman Empire.)



TYPICAL CROSS-SECTIONS



LONGITUDINAL SECTION

Probably the most ambitious single work of Roman engineering was the "emissarium" or outlet for Lake Fucinus, completed in reign of Claudius, about 50 A.D. This tunnel 3½ miles long, partly in hard rock and partly in clay and sand at great depth, seems to have been only partially successful in draining the lake. Note the numerous shafts. All the inclined ones, or "cuniculi," are not shown. Later work uncovered mistakes in the alignment of headings.

Dynamic testing of concrete evaluated

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Since 1938, when Powers[1] published the first comprehensive report on the application of a non-destructive testing technique to concrete specimens, few years have passed without some notable contribution in this field. The widespread interest in these techniques is evidenced by the increasing number of papers describing their use in specific applications, such as the recent article by Armstrong, Ulp, and Larson[2] in CIVIL ENGINEERING.

Subsequent to Powers' work, apparatus was developed by Thomson[3] which did not differ materially from apparatus presently commercially available for performing resonance tests on concrete. All such devices include a variable-frequency signal generator, an amplifier, a device for converting the electrical signal to mechanical energy and imparting it to the specimen, a device for detecting the mechanical vibration of the specimen and converting this vibration to electrical energy, a second amplifier, and some device, either a meter or an oscilloscope, for observing the level of the generated electrical oscillation. A wide variety of components meeting these requirements are available and have been used by various investigators. The techniques involved are clearly specified in ASTM Designation C215-55T.[4]

The principal limitations on the use of these techniques are that the specimen must be small enough to permit its forced vibration through the use of available equipment, and that it must exist in one of a relatively few shapes so that the shape factor required in the computations of dynamic modulus of elasticity can be determined. In practice, the specimen must be either a cylinder or a prism having a uniform cross section either square or rectangular.

The same apparatus used for determining resonant frequency can, if it is of sufficient quality and accuracy, be used to determine the damping constant of the specimen. This constant is defined by

$$Q = \frac{f_0}{f_1 - f_2}, \text{ where}$$

Q = damping constant
f_0 = resonant frequency of vibration, in cycles per sec
f_1, f_2 = frequencies on each side of resonance at which amplitude is $1/\sqrt{2}$ times amplitude at resonance

Precise measurement of frequency and amplitude level is required in this determination. The use of a meter to measure amplitude level and of a frequency counter to measure frequency have been found satisfactory for measurements of this nature.

If a cathode-ray oscilloscope and appropriate photographic equipment are available, the logarithmic decrement

can also be determined. This property is defined by

$$\delta = \log e \frac{A_1}{A_2}, \text{ where}$$

δ = logarithmic decrement

A_1, A_2 = amplitudes of two successive vibrations, at resonance, after driving force has been removed from specimen

To determine A_1 and A_2, the cathode-ray oscilloscope is used to observe the vibration of the specimen. When resonance has been located, the driving power is turned off and the decay of the specimen vibration recorded on a moving film strip. Amplitudes of successive cycles can then be accurately measured from the developed film.

Velocity of pulse propagation

Since about 1945, considerable attention has been directed to the development of apparatus for measuring the velocity of pulse propagation through concrete. These investigations have produced such apparatus as the Soniscope in Canada and the United States, the ultrasonic concrete tester in England, the electronic interval timer by the U. S. Corps of Engineers, and the microtimer by the Bureau of Reclamation. Descriptions of these devices have been given in detail elsewhere[6] and will not be repeated here. Briefly, each of them involves the introduction of a burst of energy into the concrete and the measurement of the velocity with which this impulse travels through the concrete. This testing technique is not materially influenced by the size and shape of the concrete tested. Tests have been made successfully through sections varying from a few inches to as much as 70 ft in thickness.

These techniques, involving the measurement of both resonant frequency and pulse velocity, are now fairly widely used. The principal remaining problem is that of proper interpretation of test results.

It is common practice to compute the dynamic modulus of elasticity of concrete specimens from their resonant frequencies. This computation appears to be proper and is necessary if specimens of different sizes are to be compared. The use of resonant frequency techniques has been confined principally to evaluation of performance of specimens undergoing freezing and thawing, or some other form of disruptive test. The technique has been found highly valuable for such use.

In the case of pulse velocity tests, it is theoretically possible to compute the modulus of elasticity from the measured pulse velocity. In this case it is necessary for the investigator to know, or estimate, the unit weight of the concrete and its Poisson's ratio. Since the size and shape of the specimen do not enter into the computation, it is possible to compare concretes in specimens or sections of different sizes directly on the basis of velocity, and many investigators with considerable experience in this type of testing prefer to do so.

Evaluating strength of concrete

It is perhaps not surprising that, as these various devices have become generally available and the techniques for their use better understood, considerable pressure has grown for their use in evaluating the strength of concrete. Recent examples are a paper by Kozan[6], recommending the determination of flexural strength on the basis of pulse velocity tests, and the paper by Armstrong, Ulp, and Larson[9], previously cited, recommending the use of resonant frequency techniques to determine compressive strengths.

The best that can be claimed on the basis of theory for the dynamic techniques described above is that they can be used to determine the dynamic modulus of elasticity, which, in the case of concrete, would be closely equivalent to the initial tangent modulus. The question that remains is whether the initial tangent modulus, or any modulus, can be accurately correlated with strength.

For many years attempts have been made to correlate modulus of elasticity with strength. Taylor and Thompson[7] in 1916, suggested that the ratio of modulus of elasticity to ultimate compressive strength was 1300. Present ACI specifications[8] make use of a ratio of 1000. Armstrong, Ulp, and Larson recommended the use of a ratio of 900. Data given in their article, however, show that this value was determined on the basis of tests on three cylinders for which the ratio was found to vary from 856 to 959 as the ultimate compressive strength, and modulus of elasticity varied from 2,350 to 3,625 psi and 2,000,000 to 3,190,000 psi respectively.

Although it is generally agreed that some relationship exists between strength and modulus of elasticity, a number of investigators have reported that no generally usable relationship could be found. In 1929, Davis and Troxell[9] stated, "There appears to be no direct relationship between modulus of elasticity and compressive strength which is generally applicable." Thoman and Raeder[10] wrote in 1934, "The modulus of elasticity varies with the coarse aggregate used. Under the conditions of these tests, the change from one sandstone to another sandstone of different physical properties increased the modulus approximately a constant value of 600,000 psi throughout the whole range of strengths from 2,000 to 11,000 psi."

In a paper published in 1946, LaRue[11] concluded, "No correlation between the compressive strength of concrete and the modulus of elasticity is evident from a study of the data." In a 1956 text written by Troxell and Davis[12] the statement is made, "Actual tests show that even when dealing with different combinations of the same materials, no universal relationship exists between strength and the modulus of elasticity, and when such variables as different aggregates are introduced, it is possible to produce concretes having the same modulus but having strengths differing by more than 100 percent."

A source of error

If the modulus of elasticity is to be determined from a dynamic method of test, any uncertainties or errors in computing the modulus from the results of the dynamic test will add to the error in estimating strength from modulus. This is particularly true in the case of the resonant frequency tests, where it is necessary that the modulus be determined.

For pulse velocity testing, this error might be eliminated by directly correlating pulse velocity with strength. Parker[13] reported the results of a study of this nature in 1953. He found essentially a linear relationship between pulse velocity and the logarithm of compressive strength, but his data revealed that as the compressive strength increases, the lower 95-percent confidence limit becomes very large. At an estimated strength of approximately 4,000 psi, the lower confidence limit is in the neighborhood of 2,000 psi. This indicates that, in the usual range of working strengths, errors in prediction as great as 1,000 or 2,000 psi may result.

Long, Kurtz, and Sandenaw[14] in one of the early papers dealing with the measurement of pulse velocities stated that they found good agreement between dynamic modulus computed from such velocities through pavements and the flexural strength of beams cut from the pavements. They presented an equation and a curve from which they suggested that flexural strength might be calculated, or taken when the dynamic modulus had been calculated. Dodge[14] in a discussion of their paper, however, pointed out that the use of this equation or curve could lead to serious error in the prediction of flexural strength.

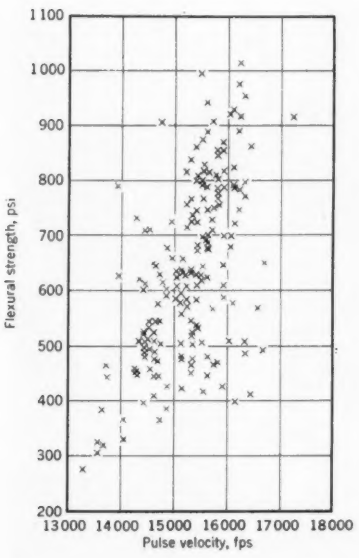

FIG. 1. Relationship between pulse velocity and flexural strength is plotted, based on tests of 6 X 6 X 30-in. prisms.

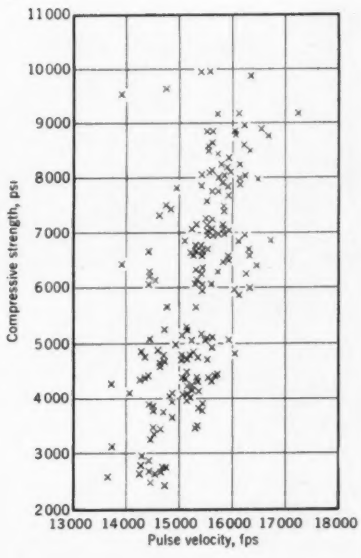

FIG. 2. Relationship between pulse velocity and compressive strength plotted from tests of 6 X 6 X 30-in. prisms.

A few years ago the writer had occasion to conduct a series of experiments permitting a comparison of pulse velocities with both flexural and compressive strengths. The specimens employed were 6 x 6 x 30-in prisms. Each was broken in flexure by mid-point loading on an 18-in span, with two tests made on each beam. The two ends of each beam were then broken in compression as modified cubes. All specimens were from one series, but the mixes varied, several aggregates and cements were employed, and three different curing conditions were used. Ages of specimens varied from 3 days to 3 months. Each specimen was tested with a Soniscope immediately before being broken.

A comparison of the pulse velocities of the specimens with their flexural strengths is given in Fig. 1. A similar comparison involving compressive strengths is shown in Fig. 2. It cannot be denied that some general relationship exists between either flexural strength or compressive strength and pulse velocity. Neither can it be denied that any curve drawn through the plotted points would be highly inadequate for use in predicting the strength of specimens selected at random on the basis of their pulse velocities.

Reference has been made to the paper by Kozan[6] in which he deals with the prediction of flexural strength from pulse velocity tests. He agrees, however, that the use of such velocities to accurately determine the flexural strength of concrete about which there is little other information is a questionable practice.

A recent study by Kesler and Higuchi[15] suggests an approach to the prediction of strength based on dynamic tests which appears to be more promising than any other reported to date. They specifically state in their conclusions that "modulus of elasticity, if used alone, is not a measure of concrete strength." However, through the use of the dynamic modulus of elasticity and the logarithmic decrement, both of which quantities can be obtained from a test of the resonant frequency type, they were able to estimate compressive strengths of cylinders concerning whose age, mix and curing conditions no information was available to them, with an average error of about 3 percent. It is believed that further investigations of this nature are in progress and that further reports may be expected.

Limitations must be recognized

It is not the writer's purpose here to deny the very real advantages associated with the dynamic testing of concrete. No better way is presently known for evaluating progressive deterioration in laboratory specimens than the several resonant frequency techniques. Similarly, no better way is now known for examining concrete in place to determine its uniformity and to determine whether or not cracks are present than the pulse velocity techniques. Exception is taken, however, to statements such as that of Armstrong, Ulp, and Larson that, "An adaptation of the equipment used in this series of experiments makes it possible to accurately estimate the strength of existing structures as much as 50 ft thick." It is assumed that the adaptation referred to is the Soniscope or some similar pulse velocity device. The great weight of published information does not support the above quotation.

It is agreed that if a sufficiently extensive series of correlation tests are performed on a concrete containing one aggregate system, made from one mix and under one condition of curing, a relationship can be established between dynamic modulus of elasticity and ultimate strength which will permit reasonably accurate prediction of strength of further concretes made to the same specifications. It is believed, however, that no such relationship has been established which is satisfactory for predicting the strength of a concrete the history of which is unknown to the investigator. Any such prediction should be made only with a clear appreciation of the probable error involved.

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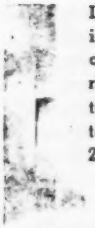
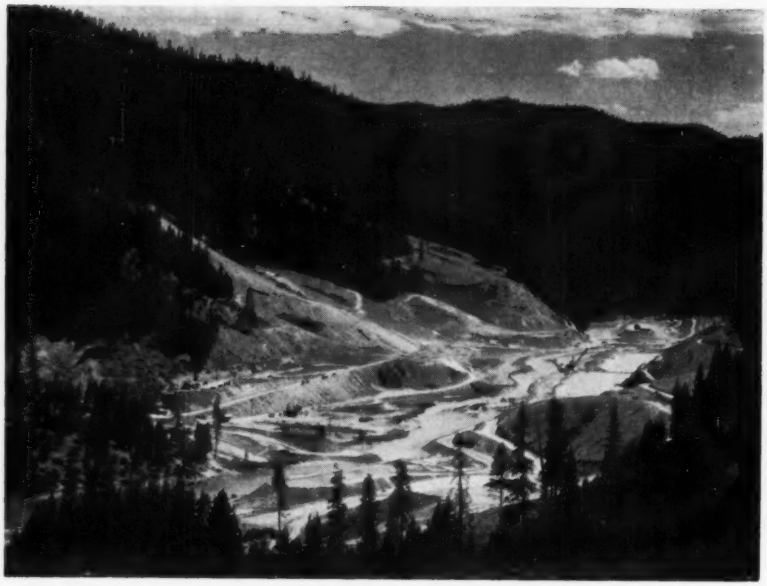


Left abutment of Trinity Dam is cleared area at left center of photo. Knoll on far side of river in background is potential slide area from which material will be taken for Zone 2 embankment.

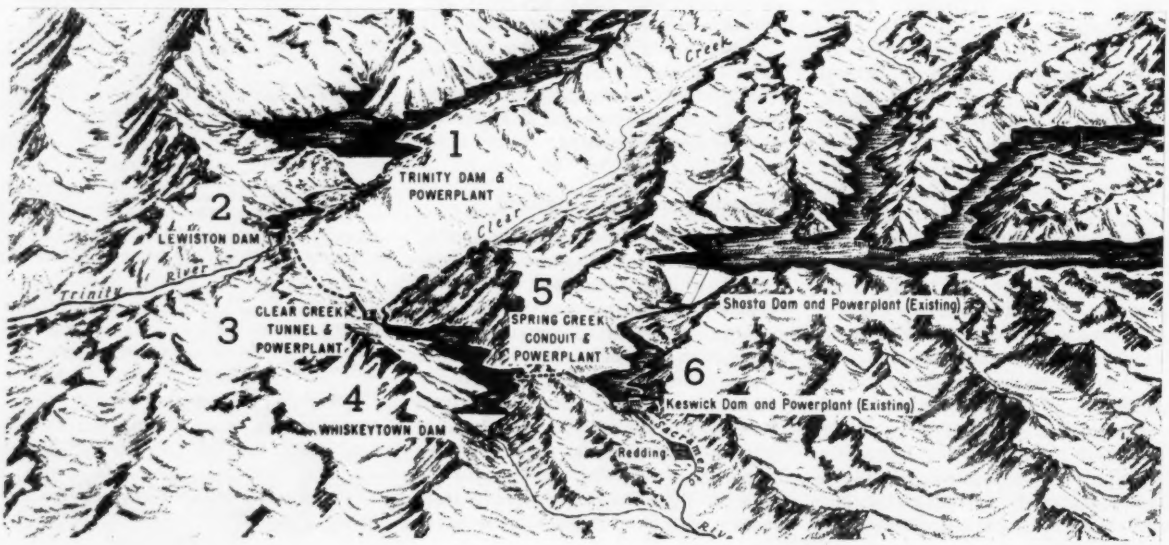
FIG. 1. Trinity River flows through mountainous area with limited water demand. Much of its flow can therefore be diverted to California's great Central Valley.



Construction begins on

CARL J. HOFFMAN, M. ASCE
WILLIAM E. COLLINS, M. ASCE

FIG. 2. Long-term plan for Trinity River includes: (1) Trinity Dam, a 29,000,000-cu yd earthfill structure; (2) Lewiston Diversion Dam, which will force water into (3), Clear Creek Tunnel, 10.8 miles long, which carries 3,200 cfs through divide to power plant with 560-ft head, which discharges into (4), a reservoir to be formed by proposed Whiskeytown Dam, 278 ft high, from which water will be carried by (5), Spring Creek Conduit, to powerplant of 565-ft head above (6), Keswick Dam on Sacramento.



Trinity Dam 537 ft high

Engineers, Dams Branch, Bureau of Reclamation, Denver, Colo.

Construction began in April 1957 on what will be one of the highest earthfill dams in the world. It is the 537-ft-high Trinity Dam, principal feature of the Bureau of Reclamation's Trinity River Division of the Central Valley Project in northern California. See Fig. 1. The dam and other Division structures, as authorized by Congress in 1955, are shown in Fig. 2. They will ultimately make possible the average annual transbasin diversion of 865,000 acre-ft of surplus waters from the Trinity River watershed to the adjacent Sacramento River Basin, thus augmenting the water supply of the Central Valley Basin.

The dam is being built on the Trinity River about 8 miles north of the town of Lewiston, Calif. About 29 million cu yd of earth and rock—a Bureau of Reclamation record—will be placed in the embankment. The dam will have a crest length of 2,450 ft, a crest width of 40 ft, and a maximum base width of 2,600 ft. Trinity Reservoir will have a maximum capacity of 2,500,000 acre-ft and an active storage capacity of 2,160,000 acre-ft.

In addition to its great height and large volume, Trinity Dam is unusual in Bureau of Reclamation experience in that it consists of a combination of materials not ordinarily encountered in earth-dam construction. The impervious core comprises weathered rock available in the immediate vicinity of the dam rather than more "conventional" earth materials available at longer haul distances. This is possible because of the size and efficiency of modern earth-working equipment, which can break the weathered rock fragments to the desired size as they are placed and compacted. Materials from foundation excavation and a nearby slide area are to be utilized between the impervious core and the outer pervious zones. Sands and gravels, including tailings piled along the river from gold dredging operations, will be used in the outer zones.

TABLE I. Trinity Dam and Reservoir, physical data

Dam:	
Type	Earthfill
Height above riverbed	465 ft
Height above lowest point in foundation	537 ft
Volume: Earth and rock fill	29,100,00 cu yd
Concrete in spillway and outlet	103,720 cu yd
Crest length	2,450 ft
Crest width	40 ft
Base width	2,600 ft
Crest elevation	2,395.0
Maximum discharge through spillway	24,000 cfs
Freeboard	8 ft
Reservoir:	
Capacity at normal water elevation	2,500,000 acre-ft
Area at normal water surface	16,300 acres
Elevation at max. water surface	2,387
Length	16 miles

First construction at the dam site began in May 1956, following award of a $1,348,000 contract to Gates and Fox Company of Burlingame, Calif., for construction of the 33-ft-diameter diversion tunnel on the dam's left abutment. Excavation of the 2,281-ft-long tunnel, which will divert the full flow of the river during construction, was completed in April 1957. The $48,928,100.52 contract for construction of the dam, which is expected to extend for 5 years, is held by a combination of the following firms: Guy F. Atkinson Co., M. J. Bevanda, Charles L. Harney, Inc., Ostrander Construction Co., A. Teichert and Son, Inc., and Trepte Construction Co., Inc. Principal quantities are given in Table I. Concrete lining of the diversion tunnel, to its finished inside diameter of 28 ft, will be completed under the dam contract.

Plan of development

The Trinity River Basin embraces an area of about 2,900 square miles lying between the northernmost part of the Central Valley and California's north coastal area. The Trinity River is a 130-mile-long tributary of the Klamath River, which flows westerly into the Pacific Ocean. Because of the rough terrain and extensive forests of the Trinity Basin, only a small part of the runoff can be utilized for agriculture and other beneficial uses. As a result, hundreds of thousands of acre-feet of water are wasted into the ocean. The transbasin diversion will not only put this water to beneficial use but will also make possible the production of power.

Average annual runoff of the Trinity River at the point of diversion is about 1,100,000 acre-ft. It is estimated that no more than about 120,000 acre-ft annually are needed downstream to satisfy irrigation, municipal, and industrial users, and to provide flows for recreation and fishery needs. The yearly runoffs of the Trinity River are erratic, ranging during a 20-year period from 260,000 to 2,550,000 acre-ft. Approximately 75 percent of the runoff results from snowmelt and spring rains occurring from February to June. Trinity Reservoir will capture this seasonal runoff and supply holdover storage for years of less than average yields.

As authorized by the Congress, the Trinity River Division is to be integrated operationally and financially with the Central Valley Project. By proper distribution of the diverted water and by making maximum use of return flows and available surplus flows, it is estimated that the Trinity transbasin diversion will yield more than 1,400,000 acre-ft a year for irrigation in the Central Valley Basin.

The more than 1,700 ft of head to be created by the transbasin diversion will also make possible the development of additional power for northern California. Four powerplants, including that at the toe of Trinity Dam, are to be built as part of the system. These plants will have a total capacity of slightly less than 400,000 kw and will generate more than one billion kwhr annually. Under the Congressional authorization, the power installations may be constructed by private inter-

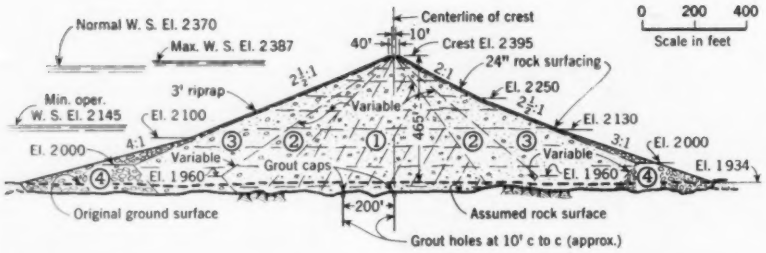


FIG. 3. Maximum section through Trinity Dam indicates four embankment zones, as follows: ZONE 1, selected weathered rock (clay, silt, sand and gravel) compacted by tamping rollers to 6-in. layers; ZONE 2, selected weathered rock (silt, sand, gravel and cobbles) compacted by tamping rollers to 12-in. layers; ZONE 3, alternating layers of selected dredge tailings (gravel, cobbles and boulders) and selected dredge screenings with selected undredged sand and gravel (silt, sand, gravel, cobbles and boulders), compacted by crawler-type tractors in 18-in. and 12-in. layers respectively; ZONE 4, rockfill placed in 3-ft layers.

ests or by the Federal Government. However, no decision has yet been made by the Congress as to the construction of the power facilities.

In addition to Trinity Dam and the power plants, other major features of the diversion plan include the Lewiston Diversion Dam, Clear Creek Tunnel, Whiskeytown Dam, and Spring Creek Conduit, shown in Fig. 2. Releases from Trinity Dam will be diverted at Lewiston Diversion Dam, about 6 miles downstream, into Clear Creek Tunnel, which will extend southeast to the upper end of Whiskeytown Reservoir on Clear Creek, a tributary of the Sacramento River. From Whiskeytown Reservoir, the water is to be carried east through the Spring Creek Conduit to Keswick Reservoir behind Keswick Dam, a feature of the Central Valley Project completed in 1950.

Lewiston Diversion Dam, of earthfill and rockfill construction, will be about 70 ft high and will have a volume of about 320,000 cu yd. The dam will have spillway and outlet facilities to meet downstream water requirements. A powerplant will be built as a part of the outlet installation.

Clear Creek Tunnel is to be 10.8 miles long, concrete lined to an inside diameter of 17.5 ft. This pressure conduit, to carry a maximum flow of 3,200 cfs, is being constructed on a grade of 17 ft per mile, and its outlet portal will be more than 500 ft above the Clear Creek streambed. The tunnel installation will include a controlled intake at the Lewiston Diversion Dam forebay, a large surge chamber near the outlet portal, and a steel penstock to convey water from the outlet portal to Clear Creek Powerplant. The powerplant will operate under an approximate head of 560 ft.

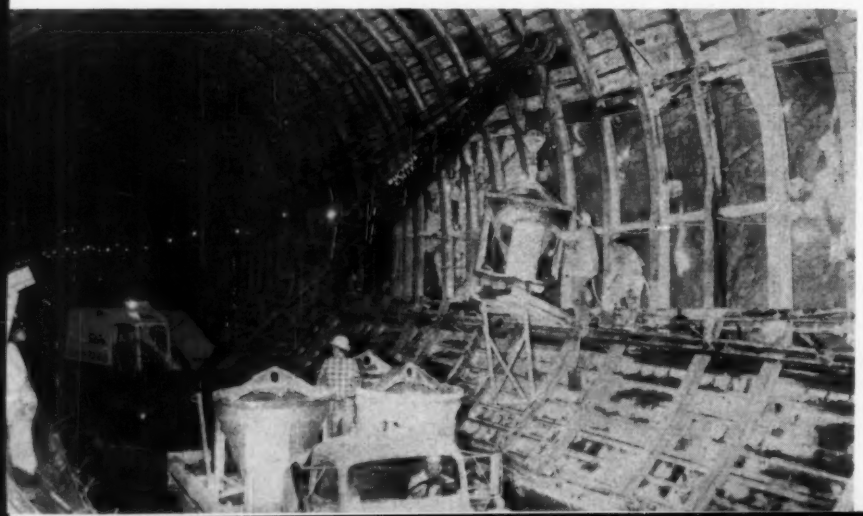
Construction of Clear Creek Tunnel began in March of this year under a $36,644,556 contract awarded to the following combination of contractors: The Shea Co., Henry J. Kaiser Co., Morrison-Knudsen Co., Inc., Macco Corporation, and Raymond Concrete Pile Co. The tunnel—a major construction undertaking—will be almost as long and nearly twice the diameter of the Bureau's longest tunnel, the Alva B. Adams Tunnel (13.1 miles long and 9.75 ft in diameter) on the Colorado-Big Thompson Project in Colorado.

As now planned, Whiskeytown Dam is to be an earth and rockfill structure 278 ft high, having a volume of 4,000,000 cu yd. It will be constructed across Clear Creek downstream from Clear Creek Powerplant. The reservoir created by the dam will reregulate flows from the powerplant and retain runoff estimated to average about 200,000 acre-ft annually. The reservoir will have a maximum storage capacity of 250,000 acre-ft.

Whiskeytown Reservoir will provide the forebay for the Spring Creek Conduit, which will serve as the connecting conveyance structure between Clear Creek and Keswick Reservoir. The conduit, which will have its entrance about 100 ft below the normal operating level of Whiskeytown Reservoir, will comprise two concrete-lined tunnels of 18.5-ft. diameter and a siphon section connecting them. The upstream tunnel will be 8,700 ft long and the downstream tunnel will be 3,500 ft long. The intervening steel-lined siphon section will have a diameter of 17 ft and a length of 3,200 ft. The conduit will carry a maximum flow of 3,600 cfs and will operate under pressure.

The conduit will discharge through a steel penstock into the Spring Creek Powerplant, largest of the Division's power installations, which will operate under an approximate head of 565 ft. In turn, water discharging from the plant will be released into Keswick Reservoir to augment the supply available at the Keswick Powerplant on the Sacramento River, increasing the generating output at that plant by an estimated 59 million kwhr annually.

Concrete is placed from 1-cu yd buckets in Trinity Dam diversion tunnel of 33-ft diameter.



Construction of Trinity Dam

Geologically, the Trinity Dam site is favorable for a high earthfill structure. In general, bedrocks in the Trinity River Region are hard metamorphic formations. Bedrock at the dam site is termed Copley meta-andesite or "greenstone," a crystalline rock resulting from low-grade metamorphism of basaltic and andesitic lavas. This rock is similar to the formation on which Shasta and Keswick Dams were built. Weathering of the meta-andesite is deep and severe, but much of the rock near the surface is sufficiently firm to support the dam.

An estimated 3,300,000 cu yd of materials—ranging from sand and gravel in the river channel to older, more severely weathered bedrock and residual soils on the abutments—will be removed from the dam foundation. Under the impervious zone, additional material will be removed to firm bedrock to assure a completely competent and tight contact.

The dam embankment consists of four zones of selected materials, each distinguished by its particular structural and permeability properties and by the method of placement. See Fig. 3. The center zone of the dam, containing 9,400,000 cu yd, is designated as Zone 1 and will form the impervious watertight barrier. The material for this zone is a selected weathered meta-andesite rock from the Copley formation. When excavated and placed in the embankment, this material breaks down into silty sand and fragmentary rock particles. Compaction, to a density of about 110 lb per cu ft, is to be achieved by a minimum of 12 passes of a tamping roller over each 6-in. layer of embankment.

The Zone 2 parts of the embankment, which flank each side of the center impervious core, contain 3,800,000 cu yd of fill. This zone is designed to utilize selected material from foundation and structure excavations, and material excavated from a potential slide area on the left abutment immediately downstream from the dam. In stabilizing the slide area, which lies directly above the Trinity Powerplant area and the outlet channels for the spillway and outlet works, 2,200,000 cu yd of the hillside will be removed. The material to be removed is weathered rock from the Bragdon formation of the Mississippian Period, and is classified mostly as silt containing some friable gravel fragments. In placing the Zone 2 embankment, compaction to a density of about 113 lb per cu ft is to be obtained by 12 passes of a tamping roller over each 12-in. layer. Both Zone 1 and Zone 2 materials when compacted have comparatively high densities. The more weathered rock is to be placed in Zone 1 and the less weathered in Zone 2.

Zone 3 parts of the embankment, which will form the pervious outer zones of the dam, contain 13,400,000 cu yd. These materials, consisting of sand, gravel, cobbles, and boulders, are to be obtained from excavations for the dam foundation and from borrow areas in the river channel upstream and downstream of the dam. Much of the Trinity River channel in the vicinity of the dam site had been mined by bucket-type dredges, leaving high piles of tailings. These yield three distinct types of material: tailings consisting of gravel, cobbles, and boulders; screenings consisting of silt, sand, and gravel, up to 3/8 in.; and undredged materials composed of silt, sand, gravel, and cobbles and boulders. This Zone 3 embankment material is to be compacted by a heavy crawler-type tractor.

Removal of materials for Zone 3 embankment will form a deepened channel below the dam. The resulting lowered tailwater will make available more than 20 ft of added head for the powerplant. Immediately below the spillway exit channel, the riverbed is being excavated to bedrock to minimize the formation of sandbars.

Upstream and downstream toes of the dam are to be protected by heavy rockfill, designated as Zone 4. The upstream slope will be surfaced with a 3-ft layer of riprap as protection against wave action, and the downstream slope will be surfaced with a 24-in. layer of rock to prevent erosion. Sound rock for Zone 4 fill and for riprap surfacing—an estimated 2,500,000 cu yd—is to be obtained from spillway and outlet works excavations and from the rock quarry. The quarry rock yields the fresher and harder Copley meta-andesite.

Spillway of morning-glory type

As a result of extensive hydrological studies, provisions have been made to accommodate a flood having an instantaneous peak of 160,000 cfs and a six-day volume of 489,000 acre-ft. As the reservoir area at normal water level is more than 16,000 acres, it is possible to store a large volume of the flood in surcharge storage space with only a small increase in dam height. Studies indicated that raising the dam to store more of the flood was more economical than providing equivalent spillway outflow capacity, and that on the basis of cost alone, no spillway was justified. By utilizing only the Trinity Powerplant and outlet works to discharge about 6,000 cfs during a maximum flood, and considering the reservoir to be full at the start of the flood, it was determined that a surcharge of 23 ft would contain the entire flood volume.

However, facilities for emptying the accumulated surcharge storage in a reasonable time were needed, so that space would be available for a recurrent flood. Accordingly, a "morning-glory" inlet spillway, connected to a 20-ft-diameter horizontal tunnel by an inclined shaft, and having a maximum capacity of 24,000 cfs, was arbitrarily selected to fill this need. With releases from this spillway, augmented by discharges from the powerplant and outlet valves, the maximum design flood, succeeded in 10 days by a flood equal in magnitude to the historic 1955 flood of record, can be accommodated by storing 315,000 acre-ft of the runoff in a 17-ft depth of surcharge.

An auxiliary diversion and outlet tunnel has been provided for river-flow diversion while the main diversion tunnel is stoplogged off for installation of the penstock system. During operation of the reservoir, this outlet will also serve for auxiliary or emergency use. The outlet consists of a 7-ft-diameter concrete-lined tunnel through the left abutment, to emerge into the lower leg of the spillway tunnel.

W. A. Dexheimer, M. ASCE, whose offices are in Washington, D. C., is Commissioner of the Bureau of Reclamation. Designs and technical supervision of construction are under the direction of L. N. McClellan, M. ASCE, Assistant Commissioner and Chief Engineer, in Denver, Colo. The Trinity River Project is in the Bureau's Region 2, of which B. P. Bellport is Director. Project Construction Engineer is L. B. Ackerman.

First overburden is being removed from Trinity Dam site by equipment of joint venturers Atkinson, Bevanda-Harney, Ostrander, Teichert and Trepte.

COFFERDAM PROBLEMS plague Harvey Tunnel constructors

CHARLES L. SLOAN, A.M. ASCE

Engineer, David W. Godat & Associates, New Orleans, La.; formerly Field Engineer, R. P. Farnsworth & Co., Inc.

Steel sheetpile cofferdams and repairs to them were the major construction problem in building the Harvey Tunnel in greater New Orleans. The new twin-barrel four-lane tunnel was opened in September to take some 25,000 cars a day under the busy Harvey Canal of the Intracoastal Canal System. It relieves a serious bottleneck on the Marrero-Algiers link of Louisiana Highway 2200. This route previously crossed the canal on a double-leaf bascule, which had to be opened several times an hour to accommodate canal traffic.

The contractors had the option of building the tunnel and floating it into a prepared trench in sections, or of building the entire structure in place. Since the minimum depth of channel in the canal is only 12 ft and the maximum cover for the tunnel is 8 ft, it was decided to build in place rather than to dredge the channel and float the sections in. Also, the float-in option would have required a special cofferdam and bulkheading arrangement as well as facilities for building at a shipway or drydock. The plan, therefore, was to cofferdam the area and construct the tube in place, much as would be done for a large box culvert. Some 3,300 tons of sheetpiling, a lot of bracing, and two years of work in mud and water went into the three cofferdams, one for each of the three stages of construction.

Canal traffic had to be maintained during construction. The three-stage sequence that was worked out required only a little more than half of the canal to be closed at any one time. As shown in Fig. 1, the three stages were:

1. The eastern half of the tunnel barrel and a part of both ramps
2. The tunnel from the west canal bank to the west portal
3. The tunnel under the western half of the canal and the remainder of the ramps

Stage 1 construction

The type of cofferdam to be used for Stage 1 was greatly influenced by the depth of excavation. The maximum depth was 14 ft of water and 40 ft of cut, or a total of 54 ft. Many plans involving several types of sheetpiling were investigated. The method that seemed most efficient, both from the economic and the engineering standpoint, utilized a system of braced master piles connected by tension piling. The master piles were made up of 36-in. WF sections to which were welded Y-piling, to serve as connectors and to add strength to the beams. Between the master piles, which were spaced 13 ft 4 in. on centers, were arcs of I-23 sheetpiling, tested to 12,000 lb per lin in. for interlock strength.

This series of arcs formed the inside walls of the cofferdam. The method was expected to require a minimum of underwater work. The arcs would transmit stress to the master piles without the need for longitudinal wales. In the part of the cofferdam that extended into the canal, these arcs formed the inside wall of the sheetpile cells installed to serve as access roads and as protection against possible damage from canal traffic.

Master piles driven on opposite sides of the tunnel were braced apart by heavy struts, one about at ground level and the other just above the sloping top of the tunnel. Below the tunnel, the reaction of the sheetpile wall was taken by a slab of tremie concrete from 3 to 5 ft thick, which also acted, in combination with timber piling, to prevent tunnel uplift during construction.

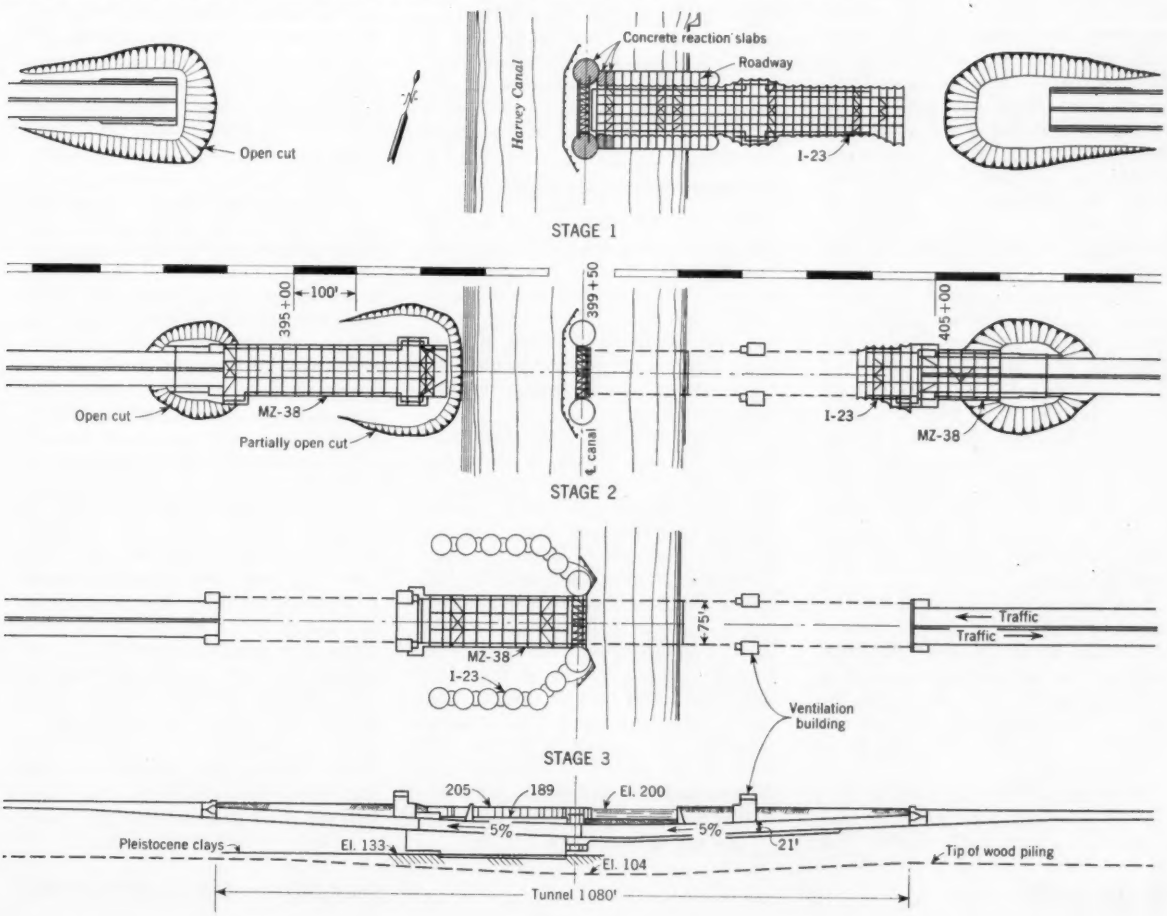
At the center of the canal, planned to be part of the cofferdam for Stages 1 and 3, two circular sheetpile cells were installed to: (1) anchor the cofferdam, (2) support the end closure, and (3) serve as a buffer if the fender system should prove inadequate. In these cells provision was made to support two horizontal trusses spanning about 75 ft across the end of the cofferdam. These had to resist the thrust of the MZ 38 piling with a head of 25 ft of water plus 29 ft of saturated clay. The lower of these two horizontal trusses weighed 104 tons. It had eight panel points and supported a total load of 1,705 tons, or 487 kips per panel point. In addition, it carried a 332-kip axial load. The upper truss weighed 50 tons and carried a panel-point loading of 136 kips, a total load of 952 kips, plus axial load.

The chord members were anchored in 3-ft-thick slabs of concrete inside the cells. The two cells adjacent to each of the round cells also had concrete slabs in them to help take the truss reactions. Timber piles driven under water supported the lower truss; the upper truss was supported on a pipe frame set on the lower truss, but it too was set underwater.

As an added precaution, inclined struts were installed at No. 1 and No. 8 panel points to take the end reactions of the lower truss in the event the cells moved inward. The lower ends of the struts were embedded in concrete, with 17 timber piles 55 ft long taking the reaction. A 4-in. gap was

In first-stage cofferdam for tunnel under Harvey Canal, master piles braced across opening are connected by arcs of I-23 sheetpiling. At center of canal, two circular sheetpile cells support two horizontal trusses which close end of cofferdam.

FIG. 1. Harvey Tunnel is being constructed in three stages. A master-pile and arc plan was used for Stage 1 (top), and braced Z-piles for Stages 2 and 3. Profile of Stage 3 and completed Stages 1 and 2 are shown at bottom.



Pulled-out interlocks in Stage 1 cofferdam were repaired, and eccentric stress on master beams controlled, by 1-ft-thick wall of concrete placed against sheetpiling in underwater forms. Heavy rods bent to the sheetpile arc were installed on 1-ft centers between master beams before concrete was poured. Note tops of wood piles which will support tunnel.

maintained between the truss and the inclined struts to permit the truss to move, allowing the cells to take as much of the reaction as possible before the struts were brought into action. After final unwatering, this 4-in. gap remained, indicating little movement of the cells under full load.

Construction sequence worked out

All bracing above the water level was installed soon after the sheetpiling was driven. Excavation then proceeded under water, but only deep enough to allow installation of a system of bracing one foot above the tunnel. This bracing was installed as the water level permitted during a partial unwatering. As soon as this installation was completed, the cofferdam was allowed to fill with water to reduce pressure before excavation was continued to plan depth.

Timber piling was driven for tunnel support and for protection against upheaval. All the support piles in the cofferdam area were 55 ft long, and the water was about 50 ft deep. A 44-ft-long follower was used with telescoping leads 100 ft long, and an underwater release device, operated by a rope to the surface. Anchors were placed at the top of the piling before driving to provide a bond between piling and tremie concrete for hold-down purposes.

Some additional excavation was required to take care of missed spots or heave from driving. A clamshell bucket could not be used for this because it would not go between the piling. Instead, a combination of water jet and air lift was used for some 1,500 cu yd of final grading.

Following the final grading, a layer of sand 1 ft thick was spread and the 3 to 5-ft tremie seal placed. Well points were buried in the sand layer and piped up through the tremie concrete to relieve the hydrostatic head.

Final unwatering of the cofferdam revealed sound tremie concrete with laitance from 2 to 8 in. thick. The concrete varied from a foot below to a foot above grade; some had to be chipped down so that the piling could be cut off at plan elevation. On the tremie seal, a 12-in. reinforced concrete leveling course was placed, providing a depth of 9 in. over the tops of the piles, which were embedded in it 3 in. Keyways were formed in the leveling course on 20-ft centers to prevent downhill sliding of the tunnel base slab.

Cofferdam failures and repairs

The first cofferdam failure was encountered during the partial unwatering, when the bracing just above the level of the tunnel roof was being installed. One of the MZ-38 piles in the end wall was found to be out of interlock. Underwater measurements were taken and a tapered section installed to repair the wall.

Further failures were discovered during the final stages of excavation while pile driving was in progress. Of the bays composed of I-23 sheeting and master piles, one-third had one or more piles out of interlock. Some were out of interlock only near the bottom of the excavation while others were out as high as 20 ft above this level. From measurements taken with the help of divers it was found that these interlocks, once started, had a tendency to open up much like a zipper. In some cases, openings 30 in. wide were found at the excavation line. Divers made a continuous investigation of all cells as excavation proceeded to find any piling out of interlock.

The first method tried to remedy this difficulty was to pull and redrive the piles. To provide for the tension in the cells during this operation, a special yoke was devised to keep adjacent master piles from moving apart. The redriving method worked well on cells that could be pulled. However, most of the piles that were out of interlock were so badly deformed they could not be pulled. It is interesting to note that in two of the cells where piles were pulled and redriven, the piling again came out of interlock, despite elaborate precautions to prevent it.

The number of interlock failures indicated at an early stage that some production method of repair, adapted to underwater application, would have to be devised, as opposed to methods suited to individual cases. What finally evolved was a system of tension rods embedded in concrete. The rods were of 2¼ or 2½-in. diameter, bent to a radius parallel to that of the sheetpiling arc. The ends were threaded, stuck through the webs of the master piles, and held with a nut and tapered washer. Concrete was poured between neighboring master piles to keep the tension rods from straightening out.

After these repairs were completed, unwatering was resumed. During the unwatering two of the master piles failed in the area where the cofferdam wall was not straight. The webs were bent and the front flanges bent about the minor axis. Deformation occurred at the struts.

As a precaution against further delay, a reinforced concrete wall was poured against the sheetpiling arcs from a point just east of the ventilation building to the round cells at the canal end of the cofferdam. This wall had a minimum thickness of 12 in. and was poured up to about the elevation of the top of the tunnel. This wall had to be constructed entirely under water.

To accomplish these underwater repairs, forms were devised to meet a variety of conditions—but also to maintain a high degree of simplicity so that divers could set and strip them in a short time in total darkness. After two attempts, one unsuccessful and one with fair results, two types of forms were built that met all the conditions. The form used is shown in the photo above. For this last use it was left in place until after dewatering.

At locations where master piles failed, holes were punched in the tremie seal and additional wide-flange sections were grouted in place alongside the crippled sections. As the wa-

ter was lowered, struts were attached to the newly installed master piles and stressed to relieve the load on the crippled members and thus prevent further crippling.

Construction Stage 2

The second-stage cofferdam extended from the west bank of the canal westward to the tunnel portal. After so much trouble with the Stage 1 cofferdam, the original idea of using a similar type for Stage 2 was discarded. Instead, MZ-38 piling was used with a system of horizontal wales and struts.

At the deep end of the cofferdam, a 10-ft open cut was made and MZ-38 piling driven. As soon as excavation permitted, the upper system of bracing was installed and excavation continued to a level just below the lower bracing. Digging operations were then suspended.

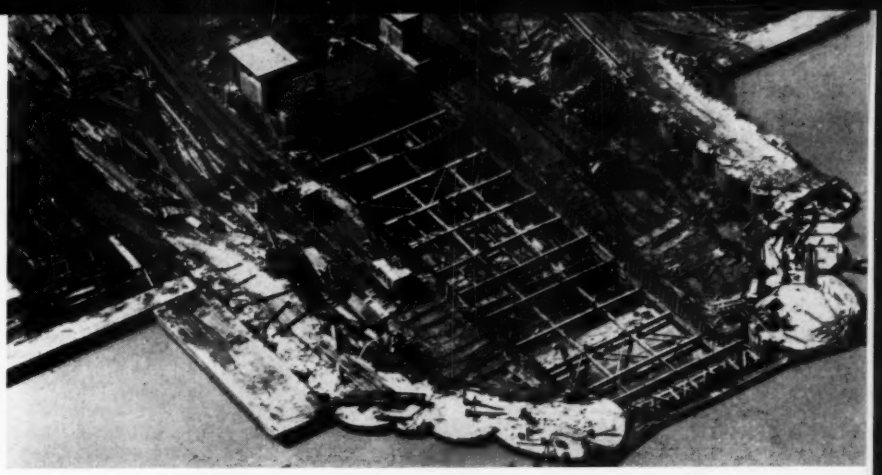
After the lower bracing was installed, the permanent timber piles were driven, using a follower to get the tops down to grade. Working from the upper end of the cofferdam, as soon as the piles were driven in an area 60 ft long, the bottom of this area was excavated to subgrade. The piles were cut off and anchors fastened to them. Then a 12-in. layer of sand and shell was placed on the subgrade and a 12-in. reinforced-concrete leveling course poured. The shell and sand layer provided relief for the hydrostatic head.

As the slab pours were made, backfill concrete was placed between the slab and the cofferdam wall. This preceded removal of the lower bracing, to keep down the span length of the sheetpiling.

During construction of the barrel in Stage 2, one of the welds in the truss at the end wall failed, and the end wall began to move in. To relieve pressure on this wall, a ditch was cut in from the canal and the cofferdam flooded. Repair was accomplished and normal construction resumed in about a week.

The next step in the construction sequence was to remove the Stage 1 cofferdam so that canal traffic could be rerouted to the east side of the canal and Stage 3 cofferdam started.

At this point the tunnel barrel had been poured to within 10 ft of midchannel. Back from the end of the barrel about 2 ft, a bulkhead of sheetpiling was built around the outside of the tunnel and tied into the cofferdam. In effect it amounted to a bulkhead with the barrel sticking through. This made up the end wall for the Stage 3 cofferdam.



For second half of canal section (Stage 3), a different construction method was used. An outside cellular cofferdam permitted starting conventionally braced MZ-38 sheetpiling at elevation of canal bottom.

Sand backfill was placed up to the elevation of the tunnel roof. Earth backfill was used from that elevation up to the dredged depth of the canal. The canal portion of the cofferdam was then flooded in preparation for removal of the Stage 1 and 2 sheetpiling.

In the canal section, only the sheetpiles in the outside wall and cross walls could be pulled, since the inside wall had concrete placed against it. Piles in the canal that could not be pulled were burned off under water by divers; those on land were burned off just below the finished grade.

Sheetpiling from the cofferdams for Stages 1 and 2 was used for the Stage 3 cofferdam, but with a different plan. This cofferdam enclosed the tunnel from mid-channel to the west ventilation building.

Stage 3 construction was done in two cofferdams, one within the other. The outer cofferdam was a cellular-type gravity section, the inner one a braced system. The cellular section served to hold back the canal water, leaving the canal bed open. A special feature of construction was a lightweight template used for driving the cells in this section. It was made of 1½-in. and 2-in. pipe and was supported on 6-in. pipe spuds. One crane was used to handle it. Credit for this innovation is due J. E. Walters, who developed this type of template on Pickwick Lock. In a number of instances the complete cycle of setting the template, placing the piling, and removing the template, was accomplished in two 8-hour shifts. The cost of the template was about $250 per cell, or about half the built-in-place cost.

A braced cofferdam of the Stage 2 type served from the canal bottom to subgrade. It was installed and braced with special care. The available 60-ft-long MZ-38 sheetpiling was driven a few feet into pleistocene clay from rigs working inside the cellular cofferdam on the old canal bed. The cofferdam had two lines of horizontal wales, with cross struts 20 ft on centers. Diagonal bracing in both the vertical and horizontal planes prevented twisting and excessive stress. Wood piles were driven with followers before excavation was complete. A tremie seal was not used.

Construction in Stage 3 proceeded much the same as in Stage 2 with two exceptions: there was no end wall with which to contend, and excavation was started at the deep end rather than at the high end in order to get started on the mid-channel pumproom as soon as possible.

Harvey Tunnel was designed by Palmer and Baker, Inc., of Mobile and New Orleans, for the Louisiana Department of Highways. The designers have planned for almost automatic and foolproof operation. Electric power comes from two separate utility systems on opposite sides of the canal, and an emergency diesel generator is backed up by batteries that will power essential services if all other sources fail. Sufficient air is blown into the tunnel at roadway level to give a complete change of air every two minutes. Indirect fluorescent lighting varies in intensity at the portals, providing higher intensity on sunny days.

Construction was done under a $4,354,000 contract by R. P. Farnsworth & Co. Inc., with Mason and Hanger-Silas Mason Co. Inc. as joint venturers. R. B. Jewell, M. ASCE, was project manager.

Supervision of construction was handled by Palmer and Baker Inc., with Arthur T. Lewis as resident engineer.

Steel water tank of 400,000-gal capacity, standing squarely in path of worst tornado in history of Kansas City, Mo., escaped practically undamaged. This May 1957 twister almost totally destroyed shopping center at upper right of tank and took 37 lives. Tank with ellipsoidal roof and bottom is supported by eight tubular columns with eight bays of diagonal rod bracing, all butt welded.

Elevated water tank defies tornado

CLARENCE D. MILLER, A. M. ASCE

Structural Engineer, Chicago Bridge & Iron Company, Chicago, Ill.

When the tornado of May 20, 1957, struck suburban communities south of Kansas City, Mo., it literally demolished everything in its path with the lone exception of an elevated steel water tank of 400,000-gal capacity. This tank, built by Chicago Bridge & Iron Company in Hickman Hills in 1953 for Public Water Supply District No. 1, has an ellipsoidal roof and bottom and a height of 142 ft 4½ in. to the high-water level. It is supported by eight tubular columns of 30-in. diameter and a center riser of 4-ft diameter. The tank was designed according to AWWA specifications for a 100-mph wind. Many people have wondered why this tank is still standing while others have failed under similar circumstances.

Records of some of the past failures of elevated tanks subjected to tornado forces have been studied in an attempt to answer this question. These indicate that one or more of the following factors may be responsible:

1. Large flying objects hitting and crippling one or more of the main supporting members
2. Vacuum or uplift forces of sufficient magnitude to lift the entire tank and tower from its foundation
3. Rotational friction and pressure drag on the tank resulting from the high tangential wind velocities

One example of each of these types of failures is cited below.

On April 5, 1936, a tank of 100,000-gal capacity with a height of 100 ft to the low-water level, in Tupelo, Miss., was in the path of a tornado. The tank failed when the legs buckled from the impact of a house or part of a house which was being carried along by the tornado.

In April 1938, a tank of 60,000-gal capacity in South Pekin, Ill., with a height of 105 ft 3 in. to the low-water

level, was lifted bodily from its foundation as evidenced by the tension failure of all four 2-in.-diameter anchor bolts. The tank was half to two-thirds full of water at the time.

At Leedey, Okla., on May 31, 1947, a 30,000-gal tank, with a height of 105 ft to the low-water level, was hit by a twister. The rotational drag on the tank was so great that the tank and tower were twisted more than 360 deg counterclockwise. The twisted tower looked like a pretzel.

It is interesting to note that although elevated tanks are normally designed for a horizontal wind force, it appears that none of the failures from tornadoes was caused by this type of loading.

With the above history of past failures we directed our attention to the Hickman Hills tank. The accompanying aerial photo clearly shows it was in the direct path of the tornado.

Examination of the tank revealed no dents in it or its tubular columns although the paint was badly chipped by wind-blown debris and the windward side of the tower was plastered with mud. A chain-link fence which originally enclosed the tower site was either flattened or torn entirely from its concrete footings.

The ability of this tank to resist lifting forces was very good. At the time the tornado struck, the tank was three-fourths filled with water, which resulted in a combined water, metal, concrete and earth load of about 3,430,000 lb for the entire tank and foundations. It might be added that the anchor bolts are of sufficient size to lift the concrete and earth loads considered. If the twister could conceivably have created a full vacuum above the 46-ft-diameter tank, the total uplift would have been about 3,510,000 lb. The roof was checked for an internal pressure of 14.7 psi—equivalent to a full vacuum on the outer surface. This pressure would not produce tensile stresses beyond the elastic limit. Thus the roof was strong enough to withstand a full vacuum and the dead weight of the tank and water were equal to the maximum possible uplift. Assuming the occurrence of a full vacuum to be unlikely, the tank was sufficiently well anchored against uplift forces.

The magnitude of the rotational friction and pressure drag produced by the high tangential wind velocity is unknown. The major effect of this drag is to try to rotate the tank and tower. The rotating action is resisted by the diagonal bracing in all the bays, and each rod will provide equal resistance. Under normal wind loading the rods are not as efficient. The resistance provided by each diagonal rod is proportional to the cosine of the angle that the plane of the rod makes with the direction of the wind. For an eight-column tower the wind resistance would be equivalent to about five of the eight rods acting.

A comparison of the construction features of the two tanks will possibly give an insight into why the one failed whereas the other is still standing. The Hickman Hills tank has an ellipsoidal roof and bottom and is supported by eight tubular columns with eight bays of diagonal rod bracing. Both tank and columns are of butt welded construction.

The Leedey tank had a conical roof and ellipsoidal bottom and was supported by four angle columns with four bays of diagonal bracing. The entire tank and supporting tower were of riveted construction.

The streamlining effect of tubular columns and welded construction undoubtedly greatly reduces the pressure drag on both tank and tower. Another important characteristic of the tubular column is its equal section modulus in all directions. This factor adds considerable torsional resistance to the tower.

Although our past records indicate only the three aforementioned causes of failure, there are undoubtedly more that could be cited. Some logical reasons have been presented as to why the Hickman Hills tank did not fail. However, it seems unlikely that complete design criteria can be established for a tornado-resistant tank because of all the unknown quantities.

Another factor that may be important is the duration of the forces involved. The funnel of the tornado which struck the Hickman Hills tank was moving at a ground speed of 50 miles per hour as compared with 15 to 25 miles per hour for the average twister. It was estimated that the full effect of the tornado on the Hickman Hills tank lasted about 3 sec.

Tornado twisted tank and tower in Leedey, Okla., more than 360 deg in 1947 disaster. Elevated tank of 30,000-gal capacity, with height of 105 ft to low-water level, was supported by four angle columns with four bays of diagonal bracing, all of riveted construction.

ENGINEERS' NOTEBOOK

Helicopter joins erection crew

N. O. SAULTER, M.ASCE

Vice President, Acorn Iron Works, Inc., Detroit, Mich.

Serving as a skyhook, a Bell 47 H helicopter recently set a 40-ft spire for the $5,000,000 Kirk-in-the-Hills at Bloomfield Hills, Mich. Since this helicopter could lift only 600 lb, the spire was cut into five parts 6½ to 13 ft long. These were prepared in the shop for temporary erection bolts and subsequent welding. The sections were hoisted successively into place in an hour and a half of working time. The total time the helicopter was in use, from airport to airport, was 4 hours at $75 per hour.

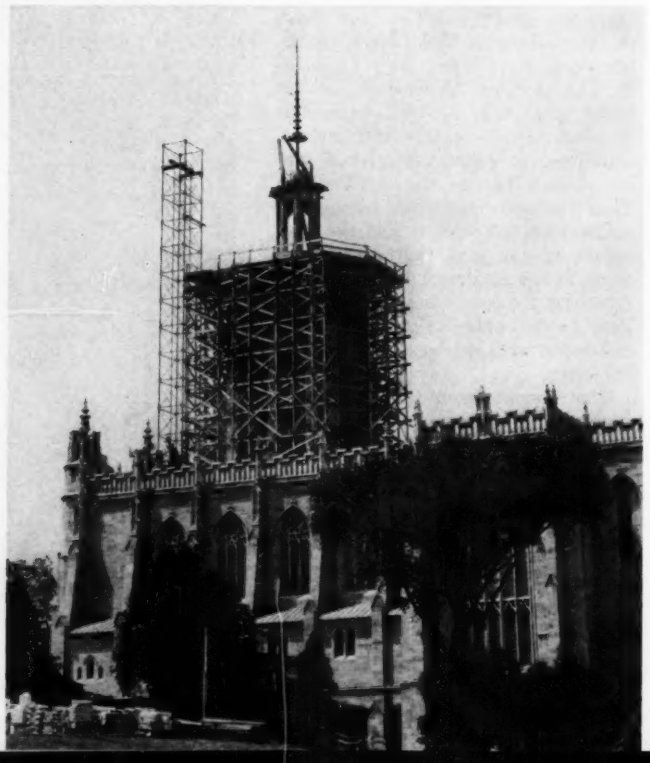
The usual method of erection would have required a heavy crane with a 190-ft boom, which would have endangered the concrete of the church around the tower. However, the main objective of this departure from conventional methods of erecting structural steel was to ascertain whether a helicopter and its pilot could function effectively as an integral part of an erection crew. The pilot had no difficulty in hovering over the structure and holding the parts to be erected in position while the iron workers on top of the tower made the necessary connections.

A foreman, two connectors, and two ground men made up the erection crew. After each section of tower was erected by the helicopter, the iron workers added a 5-ft section of Safeway scaffolding to provide a working platform. This operation consumed only about 10 minutes each time.

A four-point suspension system of rigging, employing 1000-lb aviation cables, was used with a spring-type safety hook to hold the load about 10 ft below the bottom of the helicopter, directly under its center of gravity. The load could be released by a line to the erector on the structure or by an emergency line running to the pilot in the cockpit.

Since this helicopter is not equipped with a mirror to permit the pilot to view the operation, the signals were given to him by a walkie-talkie in lieu of the conventional hand signals.

Now that the way has been paved, more of the potentialities of the helicopter as a sky hook for construction purposes will no doubt be explored, particularly when helicopters with greater lifting capacity become available.



Section of church spire is delivered to construction crew by Bell 47 H, thus proving practicability of steel erection by helicopter. Below, helicopter-erected spire rises 40 ft above Michigan church.

Nomograph solves superelevation equation

LYNDON C. ALLEN, J.M. ASCE

Designing Engineer, Texas Highway Department, Abilene, Tex.

The accompanying nomograph, Fig. 1, has been prepared for the solution of the basic superelevation equation,

$$V^2 = 15\ R\ (E + F)$$

in which

V = velocity, miles per hour
R = radius, ft
E = superelevation, ft per ft
F = friction factor

The left-hand scale of the nomograph shows the radius, in feet, on one side of the line, and the degree of curvature on the other. The right-hand scale designates the velocity, in miles per hour. The center scale gives the combined value of E, superelevation in feet per foot, and F, the friction factor.

Superelevation and friction factor have been combined on a single scale to give nomograph users latitude in choice of friction factor. This was felt to be the most logical form for such a diagram. The designer of the diagram, by combining these two factors, has avoided imposing his own personal choice of friction factor on users of the nomograph.

To illustrate the use of the nomograph, a dashed line has been drawn connecting a curvature of 20 deg with a velocity of 35 miles per hour. The point of intersection of this dashed line with the middle scale indicates an $E + F$ value of 0.28.

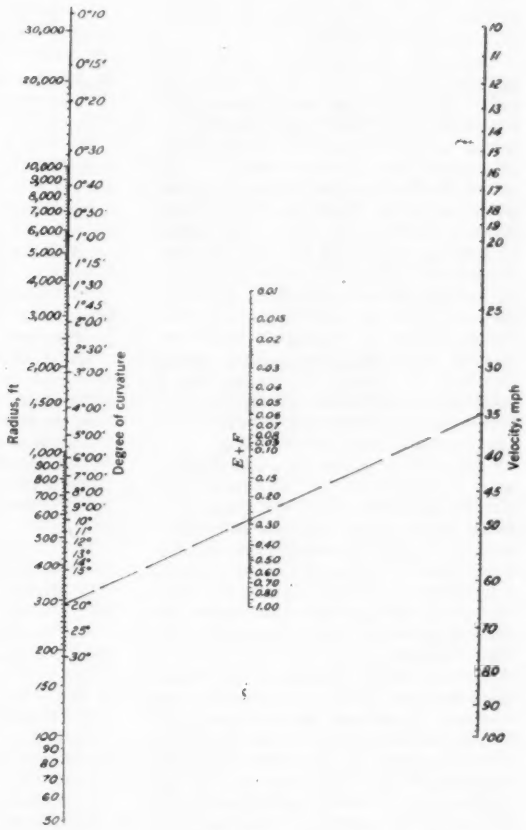


FIG. 1. Nomograph solves basic superelevation equation, $V^2 = 15\ R\ (E + F)$

THE READERS WRITE

Reinforced concrete building survives hurricane

To THE EDITOR: I was much interested in the News Brief item, "Concrete Courthouse Saves Hundreds from Hurricane" (September issue, p. 104) and the accompanying photo. A little more information on this building in Cameron, La., might be of interest.

As stated, it was designed by Herman Duncan, architect, of Alexandria, La. Mr. Duncan was proud of the job and its low cost, even at that time—1937. I was indeed sorry to learn from the item that he had passed away.

This architectural concrete building was the first in that section and was the only masonry building in the parish when it was erected. It was a PWA job. The scale for common labor was 35 cents per hour and that for skilled labor averaged around a dollar. These scales were of course set up in the specifications.

P. O. Davis of Ruston and Shreveport, La., was resident engineer in charge for the PWA, and A. Farnell Blair, whose office was in Lake Charles, La., at that time, was the contractor. The writer was general superintendent for Mr. Blair and was closely connected with this job. Richard Arlt, who came to us from the Procurement Division of the Treasury Dept., was our superintendent on the job.

One job condition was that every pound of material had to be shipped to Lake Charles and barged to the job. To reach the job, it was necessary to take two different ferries.

J. W. GADDY, A.M. ASCE

Anderson, S. C.

How can inflation be prevented?

To THE EDITOR: The article, "Can we afford more public construction?" by Col. R. B. Warren, in the August issue (p. 46), contains, I believe, many misleading statements and implications on economic matters.

The author states that, ". . . depressions are not caused by the supply of money but by its circulation—or lack of it." Let me suggest that lack of circulation of money is a *result* of a depression rather than a cause.

Again, "If labor unions had been organized to the point where they are today, the 1929 crash would never have happened. . . . Today labor unions are strong enough to prevent this sequence of events from getting started." This is the purchasing-power theory of prosperity, which is, I believe, just as ideologically dead as the rest of Keynesian economics. It should be obvious that depressions cannot be prevented simply by having all employers agree to maintain payrolls—any more than prosperity can be created by having all employers increase payrolls. Thus falling wages, like lack of money circulation, are a *result* of a depression and not a cause, and similarly, rising wages are a *result* of prosperity rather than a cause.

Colonel Warren quotes C. C. Balderston on the subject of preventing inflation, claiming that, "It requires the combined action of general monetary policy and of prudent decision-making by labor leaders, business executives, and consumers. . . ." This constitutes a claim that labor and business leaders and the general public can take direct action to stop inflation.

Inflation is an increase in the supply of money and credit with respect to the amount of exchange business available in the marketplace. It is not simply a rise in prices, as is often popularly assumed. Now, as the author correctly implies, the United States Government has complete control of the country's money. Thus it is the Government that is doing the inflating of the money, *not* the public, or labor and business leaders. The Government does this both by the age-old device of printing paper money, and by the more sophisticated modern technique of monetizing the public debt. And, obviously enough, rising prices are the *result* of inflation, and not the cause.

It seems regrettable to me that there is so much general misconception on these and other fundamentals of economics. Engineers, who deal in harsh economic realities, should take the lead in untangling this confusion. The resulting public benefits should serve to enhance the prestige of the engineering profession—far more so than our present efforts to accomplish this by means of public relations campaigns.

JACKSON L. DURKEE, A.M. ASCE
Designer, Fabricated Steel Constr.
Bethlehem Steel Company

Bethlehem, Pa.

* * * *

To THE EDITOR: I agree completely with Mr. Durkee that the Unions today are entirely too strong and are leading us to inflation. But I cannot agree that all action must come from the government. If we are to maintain our way of life, action must come from the people —from leaders of labor and industry and from the public—not from a strangling government.

Mr. Durkee's argument is confusing as regards cause and effect. Money supply and its rate of circulation is a condition, and we must get back of that condition to see what makes it what it is. My thinking on the depression of the 1930's is like this:

1. Productivity in the 1920's increased immensely.
2. Pay of the workers did *not* increase proportionately.
3. Money was drawn out of circulation by a limited few.
4. The result was depression; it would have happened without the stock market crash.

Today the conditions are reversed:

1. Productivity is increasing.
2. Money supply is increasing faster on account of
   - *a*) Pressure of unions
   - *b*) Easy credit
   - *c*) Low interest rates
   - *d*) Installment buying
3. Result, inflation.

The government can reduce its own spending and is doing so, and raising interest rates. It's up to the people to do the rest.

R. B. WARREN, M. ASCE
Colonel, Corps of Engineers, USA
National War College

Washington, D. C.

When was first non-Annapolis admiral commissioned?

To THE EDITOR: At the time Ben Moreell, Hon. M. ASCE, won the John Fritz Medal, it was stated in CIVIL ENGINEERING (October 1956, p. 82) that he was the first non-Annapolis officer to hold the rank of four-star Admiral in the Navy. Since I read this statement, I have been trying to check it.

In response to an inquiry, I have received a letter "by direction of Chief of Naval Personnel," dated September 13, 1957, from D. R. Harris, Commander, U. S. Navy, Special Assistant for Liaison and Technical Information. He states in part:

"The rank of four-star admiral was first established for Admiral David G. Farragut on July 25, 1866. On January 19, 1871, Admiral David Dixon Porter became the second officer to be advanced to this rank. Both Farragut and Porter entered the Navy prior to the founding of the Naval Academy at Annapolis in 1845.

"The only other officer to achieve the rank of four-star admiral prior to World War II was Admiral George Dewey, who was appointed to that rank in March 1899. Admiral Dewey was a graduate of the Naval Academy.

"Other than Admirals Farragut and Porter, the only other officer to achieve the rank of four-star admiral who was not a graduate of the Naval Academy was Admiral Moreell."

Thus it is seen that Ben Moreell missed being the first non-Annapolis Admiral by nearly 80 years.

JOHN SHELFORD, A.M. ASCE
Asst. Chief, Planning Branch,
Corps of Engineers,
Dept. of the Army

Washington, D. C.

Getting it straight for the record

To THE EDITOR: I wish to clear up a misstatement which occurred in my biographical summary, published in the October 1957 issue, pp. 87-88.

My connection with the National Railways of Mexico ended in the year 1932, when I resigned the position of Executive Vice President which I held at the time.

Beginning in 1934 and ending in 1954, I was Chief Engineer of the Mexican Railway, a different railroad system which was under British ownership until 1946. In that year it was acquired by the Mexican Government, but notwithstanding this fact its management has always remained separate from that of the National Railways of Mexico.

LORENZO PEREZ-CASTRO
Hon. M. ASCE
Civil Engineer

Mexico, D. F.

Use of term "Indochina" is frowned on

To THE EDITOR: Reference is made to the article by August L. Ahlf, M. ASCE, "Thailand's Chao Phya Irrigation Dam," in the August issue, p. 40. The caption for Fig. 1 states, "Thailand is shown shaded on map of Indochina." It appears that this sentence should read, "Thailand is shown shaded on map of Southeast Asia."

The peoples of Vietnam, Cambodia

and Laos are proud of their new status and look with disapproval on the term "French Indochina." I think the same holds true for Indonesia, or Dutch East Indies, shown on the map itself.

JOHN AUSTIN, J.M. ASCE
Sanitary Engineer, USOM

Saigon, Vietnam

Need for Glen Canyon Dam explained

TO THE EDITOR: The readers of CIVIL ENGINEERING are indebted to Mr. Dexheimer for his splendid article on the Glen Canyon Dam project in the July issue, p. 49. It is an excellent analysis of the proposed construction methods and cost.

Unfortunately the hydrology of the situation is rather slighted. The question that is bothering many people is where the water to fill the reservoir is coming from. For a number of years there hasn't been enough to fill the existing storage in Lake Mead, or else there has been some very odd water management. Of course in the forseeable future, Lake Mead will silt up to the point where additional storage will be necessary. According to popular belief this situation has not developed yet.

Many of us are not too well pleased to be paying out over a quarter of our income in income tax alone to the government when we see projects being built which are of as questionable value as this one.

Mr. Dexheimer would have added greatly to the value of his article had he included a discussion of the river hydrology, showing the use to which the vast storage space will be put. This would allay the doubts of many people. If such a justification cannot be made, he should show it in his analysis.

J. H. CREED, A.M. ASCE
Senior Highway Engr.
State Div. of Highways

Bishop, Calif.

* * * *

TO THE EDITOR: I appreciate the opportunity to reply to Mr. Creed's letter concerning Glen Canyon Dam.

It is correct that during several recent years, prior to this water year, there has not been sufficient runoff to keep Lake Mead filled. The reservoir was drawn down to supply water to meet downstream requirements. However, this year there is sufficient water to permit storage and we anticipate that the reservoir will be refilled approximately to the bottom of the flood-control storage space. On a river such as the Colorado, where flows vary greatly, it is logical to build reservoirs to conserve water in wet periods for use in dry periods and to refill in the following wet years. In fact, if it were not necessary to draw upon the water in storage during a dry period, it would be pointless to develop a large reservoir such as Lake Mead. Under the conditions recently experienced, had it not been possible to release water from storage, there would have been acute water shortages for users of water from the Colorado River.

If we assume that the next few years will have average runoff, Glen Canyon can be filled in a period of about ten years while passing sufficient water to meet the anticipated downstream requirements, including domestic use, irrigation and power. No one can forecast exactly how much runoff there will be in specific future years, but it is reasonably certain that the long-term average in the future will be close to the long-term average in the past.

Sedimentation (siltation) in Lake Mead is not a major factor in the decision to proceed with Glen Canyon at this time, although it is a long-range matter that adds to the advantages in developing such upstream reservoirs. Considering future compaction in the sediment beds, it is estimated that Lake Mead will not be completely filled for a period of roughly 500 years, without any upstream detention of sediment by other reservoirs. By the end of about 250 years, the accumulation of sediments would have an appreciable adverse effect on the reservoir operations. With upstream detention of a major part of the sediments, the effectiveness of Lake Mead will be extended far into the future.

Glen Canyon Reservoir is necessary to conserve the irregular flows of the Colorado River to help permit the states of the Upper Basin (above and including the Paria River) to use the additional water to which they are entitled by the terms of the Colorado River Compact and to release water to meet the needs, present and future, in the Lower Basin. Although, on the average, there is still considerable unused water in the Colorado River, the variations in flow make future developments impractical unless water is conserved in years of heavy runoff for use in years of low flow.

Even if every drop of the water could be regulated, there would not be a sufficient supply to meet all the potential future demands in the whole basin. Lake Mead has been adequate to meet the downstream requirements in the past but it cannot meet the entire future requirements of both the Upper Basin and the Lower Basin. Glen Canyon, and other reservoirs of the Colorado River Storage Project, were designed specifically to meet the needs of dry periods such as that which caused Lake Mead to be drawn down during the past few years.

W. A. DEXHEIMER, M. ASCE
Commissioner, Bur. of Reclamation
Department of the Interior

Washington, D. C.

Leisure as a state of mind

TO THE EDITOR: I find President Lockwood's address, "Illusions of Leisure" (in the May issue)—and readers' comments on it—very heartening indeed. Any conflict apparent among the several views strikes me as one of degree rather than of essence.

What the President proposes, I believe, is that leisure—as a state of mind—is undesirable. The active mind, pursuing any and all matters important to us, professionally or otherwise, appears a valid ideal. Earlier comments of readers only serve to emphasize such a view.

Resolution of the two-fold tension between what Huxley describes as the world of ideas and the world of experience or action, must always be carried out on the individual level. The wisdom of the thoughts expressed by President Lockwood and his discussers affords a logical beginning.

LAWRENCE W. RAYMOND, J.M. ASCE

Elizabeth, N. J.

Unity is a necessity

TO THE EDITOR: Do "Individual Engineers Want Unity?" I quote the title of the article by Mason G. Lockwood, then President of ASCE, in the August 1957 issue, p. 33.

As an individual, and as one who in times past has been the spokesman for quite a few engineers, I would like to reiterate most emphatically that engineers do want unity. Not only is it a matter of want, but as is becoming increasingly evident, it is also a matter of necessity for the group as a whole (rather than an intermittent local concern) as the problems of working conditions and income increasingly squeeze our membership. This situation is all wrong. We can accept it with the drifting complacency our employers and clients apparently desire, or we can act for each other and ourselves with the concerted action that gets results. The leaders in the Engineers Joint Council and the American Society of Civil Engineers need the repeated emphatic approval of their constituency to let the public and the governing agencies realize the facts and the weight of truth behind our words. But more important than words is our firm intention to get results before we write "completed job" in our diary.

Unity among engineers certainly should not be gained at the expense of freedom of opinion and democratic action among ourselves, but we should and must become stronger, and we must have a more effective agency for action where our mutual well-being is concerned.

Do individual engineers want unity? I would say, "There is plenty of coal in the stoker, Chief Lockwood. Steams a-popping, cast away!"

E. NEIL W. LANE, A.M. ASCE
Structural Engineer

Lodi, Calif.

SOCIETY NEWS

MERRY CHRISTMAS *HAPPY NEW YEAR*

New United Engineering Center Under Way

In response to the many inquiries that have been received about the new Engineering Center to be built in New York, the ASCE Board of Direction believes that a full review of the entire project should be presented. There follow portions of UET President Walter J. Barrett's report on UET's 53d year of operation.

The story starts in the fall of 1955, when a Task Committee of Fifteen was appointed by United Engineering Trustees, Inc., to determine where the new Engineering Societies Center should be located. It was proper that UET should appoint this important committee since it is the agency legally empowered to act for the four Founder Engineering Societies as well as for the Engineering Societies Library, Engineering Foundation, and the present Engineering Societies Building (to be replaced by the new center).

As is well known, the Four Founder Societies, in order of their founding, are the American Society of Civil Engineers, the American Institute of Mining, Metallurgical and Petroleum Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. These societies have acted together, through the agency of UET since its establishment in 1904. Its charter gives it broad powers for the advancement of the engineering arts and sciences in all their branches, including the maintenance of a free public engineering library. Corporate powers and privileges are vested in a Board of twelve Trustees, three from each Founder Society.

The Task Committee of Fifteen brought in its report in 1956, and this was approved by the Founder Societies. Its main recommendations were:

1. The Engineering Societies Center should be in New York.

2. The present site of the Engineering Societies Building should be continued in use as the site of the Center. However, it was recommended that, if rebuilding in this area proved impracticable, a comparable site should be sought in midtown New York.

3. The American Institute of Chemical Engineers should be admitted to UET. (This organization has now joined, and becomes the fifth constituent society of UET.)

4. UET should be authorized to raise money and accept contributions for the new Center; to employ architects, engineers, and attorneys for the work; let contracts for reconstruction of the present Engineering Societies Building or for a new building or buildings; pay all costs out of the Capital Fund Assets; and operate and maintain the new Center.

5. Plans for the new Center should be made with optimism with respect to the future growth of the five Founder Societies immediately involved. The facilities should be such as to attract and hold all of the engineering profession, "thus fostering unity and cooperation along broad lines."

An important development had taken place in June 1955, when a group of engineering leaders in industry and education was organized by Dr. Mervin J. Kelly, President of Bell Telephone Laboratories, Inc. His committee offered to assist in raising funds for the construction of the new Center. The aid of Dr. Kelly and his committee was gratefully accepted by UET on recommendation of the Task Committee of Fifteen previously mentioned.

Present Location Abandoned

Now UET faced an important decision. Would it be feasible to develop the site of the present Engineering Societies Building on 39th Street in New York, or should this site be abandoned? This site, if used, would be combined with that of the Engineers' Club, which faces 40th Street and joins the Engineering Societies Building back to back. A firm of architects was retained—Shreve, Lamb & Harmon Associates—and they submitted two proposals.

One proposal was to raze the present structures and erect a new building fronting on 40th Street, on the assumption that the necessary site there could be secured from the Engineers' Club. This plan was rejected when it was found that New York's setback ordinances would make it impossible to carry out such an arrangement satisfactorily.

The second proposal was to use the envelope of the present building on 39th Street but to reconstruct the interior, enlarging and modernizing it, and providing access space to 40th Street. This proposal included two stages, the first providing 189,000 sq ft of net usable space on the present site, and the second adding 53,000 sq ft by acquiring additional property on 39th Street.

This proposal was submitted to two reputable construction companies for cost estimates. The two estimates, received late in January 1957, were very close and indicated that the cost of rehabilitation was so high as to make the use of the present site unwise. Additional costs would be incurred for the temporary relocation of the occupants of the building, thus adding costs of moving out and back in, plus rent at commercial rates for from one and a half to two years. These cost factors and the fact that the result—a remodeled makeshift—would not provide an attractive reason for securing new funds, were discussed at two meetings of UET. On February 12, 1957, the Trustees decided to abandon plans for use of the present site.

Modern twenty-story building planned for new Engineering Societies Center is shown here in artist's rendering. With frontage on the United Nations Plaza, the Center will be neighbor to the Carnegie Foundation and the United Nations group of buildings. Shreve, Lamb & Harmon Associates are the architects, and Seelye, Stevenson, Value & Knecht the structural engineers.

New Site Is Found

On the same day that this important decision was made, the Trustees, with Dr. Kelly, visited a number of sites in New York. Unanimously—and enthusiastically—they agreed on a site for the new Engineering Center. It includes the entire block frontage between 47th and 48th Streets on the United Nations Plaza. This Plaza, it will be recalled, is that section of First Avenue on which the United Nations property fronts. The United Nations buildings are located directly east of the Plaza, and the United Engineering Center will be opposite the United Nations park. The corner of United Nations Plaza and 47th Street, due south of the Center, is occupied by the Carnegie Foundation building. The Engineering Center extends back from the Plaza 150 ft on East 47th Street and 225 ft on East 48th Street.

Once the site was chosen, aggressive steps were instituted to secure it, and on August 1, 1957, its acquisition was announced to the press. Title was taken to all the land except one plot of about 3,500 sq ft, and for this UET has a purchase contract to take title July 1, 1958. The cost was about $2,700,000.

Proposed Plan of Center

Space planning was started early in 1957, in cooperation with the five participating societies and with 15 other societies that wish to be associated with the Center. Results of the studies point to a building of about 230,000 sq ft, to include the Library, reading rooms, space for interpretative exhibitions of new engineering developments, and space for the administrative work of the societies. A general concept for the building has been developed by Shreve, Lamb and Harmon Associates, the architects selected for the Center. Detailed plans will be postponed until the results of the fund raising efforts are ascertained.

To serve as coordinator of the project, Clarence E. Davies has been assigned to UET by ASME. A former Secretary of ASME, he is well qualified for this post.

Financing Gets Going

The entire program is estimated to cost about ten million dollars. Of this sum, about two million will be available from the resources of UET—from its depreciation fund and the value of the present building. The remaining eight million is to be raised by gifts from industry and from the 282,000 members of the participating societies who belong to the Founder and associated societies. The drive directed toward industry, being organized by Dr. Kelly, has five million as its objective, and the membership campaign is striving for three million. At the close of this year, the drive will go into high gear.

Thirty leading members of the five UET engineering societies are included in the Industrial Campaign Steering Committee headed by Dr. Kelly. ASCE members on this committee are Past-Presidents Richard E. Dougherty, Enoch R. Needles, and Carlton S. Proctor, Vice-President Francis S. Friel, and L. J. Sverdrup.

A kickoff dinner in New York City on November 21 launched the industry fund drive. In attendance were representatives of more than 100 leading industries of the United States. Honorary chairman of the industrial fund drive is former President Herbert Hoover, Hon. M. ASCE. In addition, Alfred P. Sloan, Jr., John J. McCloy, and other prominent men will aid in the campaign.

When will the new Center be ready? This much can be said. Purchase contracts for the land do not permit ground to be broken until early in 1959. The building is expected to be ready for occupancy in the late fall of 1960.

Chicago's Construction Boom to Highlight ASCE Convention

The Society's Chicago Convention, set for the Sherman Hotel, February 24-28, 1958, will give members a chance to catch up on the many important construction projects currently under way in the area or completed since 1952 when the city was host to the memorable Centennial Convocation. Committees of Illinois Section members, under the chairmanship of Frank Edwards, are busy arranging an exciting program.

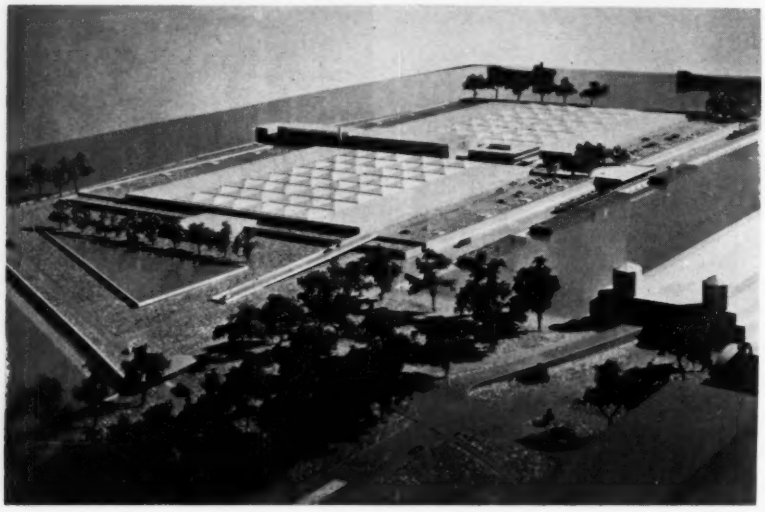
On the inspection trip agenda are such projects as the 960-mgd Water Filtration Plant, largest in the world, now under construction on the lake front. There will also be tours to the Calumet Harbor Development, the Illinois Waterway, the recently completed Congress Street Expressway, the Calumet Skyway Toll Bridge, and a wide variety of new parking facilities including the two-level Grant Park underground garage.

The Calumet Skyway, slated for completion by mid-1958, will carry traffic from the Indiana Toll Road on an elevated roadway, high above the Calumet River, into the heart of the city. A seven-mile section of the $100,000,000 Congress Street Expressway has been in operation over a year and has chalked up an excellent safety record. Chicago is the heart of a $400,000,000 system of toll roads being built by the Illinois Toll Highway Commission.

A major Midwest project under way in the area is the inland harbor being developed in Lake Calumet and the widening of the Calumet Sag Channel linking that harbor with the Illinois Waterway. This project is being built to handle the increase in water-borne traffic to follow the completion of the St. Lawrence Seaway.

For the sanitary engineer the sewage treatment facilities of the Chicago Sanitary District, rated as one of the "seven engineering wonders," will be a must on the list of places to be visited.

Practical demonstrations of electronic computers, solving some of the common engineering problems, will augment the information gained by interested engineers at the New York Convention this fall, and introduce others to these versatile and increasingly popular devices.



Chicago's new Water Filtration Plant, now under construction on the lakefront, will have a capacity of 960 mgd, making it the largest in the world.

Connecting ramp between the Calumet Skyway and one of principal traffic arteries leading to downtown Chicago is shown during construction.

Joint Events With ACI

On the social side an imaginative series of events is being planned for the members and their wives. Of interest to all will be the Get-Acquainted Party on Monday evening and the Wednesday evening banquet—both under the joint auspices of the Society and the American Concrete Institute, which is meeting in Chicago that week.

Chicago, an old hand at entertaining conventions, has many points of attraction, many of them too well known to need mention. On the celebrated lakefront are the Museum of Science and Industry, the Natural History Museum, the Adler Planetarium, the Aquarium, and the Art Institute. Among the many new structures of special interest are the Prudential Building, known for its high-speed automatic elevators, the "Top of the Rock" cocktail lounge, and the Gibraltar Room. Downtown theatres offer a variety of stage and cinema attractions. Finally, the women visitors wanting to shop are sure to enjoy the Michigan Avenue and State Street stores and some of the new outlying shopping centers.

Program in January

Watch for the January issue, which will carry the full Convention program of technical sessions, inspection trips, and social events.

M. O. Chenoweth to Head Stepped-up Public Relations Activity

M. O. Chenoweth is a recent addition to the headquarters staff in the capacity of director of the public relations department of the Society. The appointment of Mr. Chenoweth gives ASCE headquarters a public relations department on a full-time basis. In addition to handling a stepped-up program of public relations for the Society on a national

M. O. Chenoweth

scale, Mr. Chenoweth will devote much of his attention to working closely with the Local Sections on public relations matters. As part of his assignment, he expects to write on public relations for CIVIL ENGINEERING, giving ASCE members a perspective on the ramifications of public relations and how it can be handled to benefit the Society and the profession.

One of the several recommendations of the Task Committee on Economic Advancement, which were approved by the Board of Direction in October, was to increase the public relations department of the headquarters office to add emphasis to the Society's public relations program at both local and national levels. The recently completed survey of members by Opinion Research Corporation endorsed the action which has now been taken—69 percent of the members interviewed favored increasing the Society's public relations program.

For the past fourteen years Mr. Chenoweth has been associated with Selvage & Lee, industrial public relations counsel, in New York. Before entering the field of public relations, he was associated with King Features Syndicate, the Central Press Association, and the International News Service. He also served as editor of *Pan-American Magazine*. A native of Ohio, he graduated from Ohio State University, where he obtained a bachelor of science degree in journalism.

For the past six years ASCE public relations has been handled by Charles M. Bayer as public relations consultant. Mr. Bayer will continue his own public relations office in New York, which serves business and industrial concerns and professional societies. In his six-year connection with the Society, Mr. Bayer devised and carried out several public

Charles Bayer

relations projects, including the seven Civil Engineering Wonders of the United States program, which attracted nationwide interest to the civil engineering profession.

ASCE Representation in Washington Established

Official Society representation in Washington, D. C., has been arranged by the engagement of Covington and Burling, a well-established law firm of the Nation's Capital. Acting on one of the strong recommendations of the Board's Task Committee on Economic Advancement, which resulted from an intensive study by the committee, the Board at its October meeting authorized the Executive Secretary to engage that firm "to supplement headquarters office handling of Society business and affairs in Washington."

It is in the interest of the public as well as its members that ASCE concerns itself with national affairs relating to civil engineering projects, and to the education, technical development and utilization of civil engineers.

Among the services required by the Society through its representation in Washington are contacts with government agencies in which engineering functions are performed. These relate to matters concerning employment procedures and civil service. Special administrative problems requiring special attention arise through regulatory activities of such agencies as the Bureau of Internal Revenue, the Department of Justice, the Labor Relations Board, and the Department of State. Then there are situations concerning engineers in the armed services, particularly the Corps of Engineers (Army) and the Civil Engineer Corps (Navy). In national emergencies the problems in which ASCE can participate will relate to the procurement of technical manpower and materials needed by the government for engineered construction.

Another important service to be rendered relates to congressional legislation: particularly to the surveillance of bills of interest to the Society or to a substantial number of its members; to arrangements for rendering advisory assistance to and participation in hearings by congressional committees charged with developing legislation; and to the making of direct contact with those sponsoring and drafting legislation.

Representation in Washington also will maintain and strengthen Society contacts with non-government agencies, such as the Associated General Contractors, the American Institute of Architects, the National Society of Professional Engineers, the U.S. Chamber of Commerce, the American Association of State Highway Officials, and the American Road Builders Association. The representation now established will have central direction from Society headquarters—an effective and dignified engineering and legal combination which, it is expected, can obtain information, analyze a problem, and obtain remedial action without delay.

By channeling our activities in national affairs through a law firm there is good likelihood that the Society can take full advantage of its right to function in national affairs without jeopardizing its tax-exempt status as an educational and scientific organization.

In the interest of economy and efficient handling, it is intended that all Society matters needing attention in Washington be coordinated with the Executive Secretary at Society Headquarters.

Present for ceremony conferring honorary membership on Dr. Karl Imhoff in Essen are, in usual order, Mr. and Mrs. Wisely, Dr.-Ing. Franz Popel, Dr. Imhoff, Senator-Ing. Kopf, Klaus Imhoff, Dr. Ramshorn, and Dr. Koenig.

Seated group at Essen ceremonies includes Mr. Wisely, Senator-Ing. Kopf, Mrs. Imhoff, Dr. Ramshorn, Dr. Imhoff, Fabrikant Stritzel, Mrs. Wisely, and Regierungsdirektor Maas. The event took place in the beautiful Essener Hof.

Dr. Karl Imhoff Is Honored in Essen by ASCE

Conferring honorary membership on Dr. Imhoff by ASCE was more than a tribute to one of the great benefactors of mankind. The gesture honored all engineers of a great nation, and was a contribution to international friendship and understanding. The following account, taken from Secretary Wisely's diary, tells of his presentation of the certificate to Dr. Imhoff in Essen on behalf of the Society. It was the first ceremony of its kind held outside the United States.

Monday, September 23

It was truly a privilege today to make the first presentation of an ASCE Honorary Member certificate outside the United States. That this distinction should come to Dr.-Ing. Karl Imhoff, world-famous civil engineer, was particularly fitting. Only rarely is honorary membership conferred in absentia, and in this instance it was granted by the Board of Direction in deference to Dr. Imhoff's age and health.

The Germans have the knack of staging an occasion of this kind with unusual grace and dignity. These arrangements were made by Dr.-Ing. Franz Popel, M. ASCE, with the support and cooperation of the Research and Development Institute for Industrial and Municipal Water and Sewage Works Management. A close friend of Dr. Imhoff, Dr. Popel went to great pains to insure the success of the presentation.

The event took place in the Hotel Essener Hof, in Essen, which is the property of the Krupp family. It is a beautifully appointed hotel featuring many interesting antique furnishings. Only fourteen persons attended the ceremony, including Mrs. Imhoff and son Klaus, who recently graduated as an engineer from the technical university at Karlsruhe. It was a broadly representative group, however, in that Minister Kumpf, Senator-Ing. Kopf, Drs. Schreier and Ramshorn, Baudirektor Koenig, Regierungsdirektor Maas, Fabrikant Stritzel and Dr. Popel are associated with the most significant of the organizations prominent in Dr. Imhoff's career. Beside the West German government and ASCE, these include the Ruhrverband, Emschergenossenschaft, German Stream Protection Association, German Association of Engineers and the German Sewage Works Association.

The presentation ceremonies were opened by Minister Kumpf, who introduced me. Dr. Popel had thoughtfully provided each person present with a copy of my remarks both in English and German, and I made most of the statement in English. The actual presentation of the certificate, however, was made in German—of a sort. Although the Midwestern accent must have challenged the audience, the effort was received in the spirit that it was offered.

Dr. Imhoff's response was superb. The very greatness of the man was highlighted by the simple modesty and humility of his expression of thanks to the Society. It was manifest that he values this honor among the highest of the many that have come to him.

The luncheon which followed the presentation was featured by expressions of good will between the nations and engineering organizations represented in the group. Especially worthy of note was Minister Kumpf's remark that "All of Germany is honored by this tribute to Karl Imhoff."

In the evening, preceding dinner at the Imhoff home, we stopped on a hill overlooking the Ruhr to view the Essen waterworks, which were developed by Dr. Imhoff more than forty years ago. As he told us the story, I could only think that here is the finest reward of all to the successful engineer—the opportunity to look upon the product of his knowledge and judgment after it has served mankind carefully through the years. Even today Essen is developing its water supply according to the original Imhoff plan.

In honoring Dr. Imhoff, the Society has also made a worthy contribution to international amity. It is likely that the foreign activities and relationships will bring further opportunities and responsibilities of this kind.

EJC and ECPD Sponsor Joint Assembly

Contentment, better utilization and continuing education of engineers was the theme of the Joint Assembly of Engineers Joint Council and Engineers Council for Professional Development held in New York late in October. Junior colleges were lauded as a source of technicians by prominent educators, and well attended sessions heard that engineers are increasingly numerous and influential in management.

An important session dealt with an attitude survey of engineers and scientists in government and industry just completed by a White House committee. The survey developed that:

1. Government employees feel they are behind industry in pay and prospect for advancement, but have advantages in fringe benefits.
2. Ways must be found to increase freedom to develop and pursue the individual's research ideas.
3. Paper work and other non-technical chores must be decreased.
4. Greater opportunity must be provided for participation in outside meetings.
5. Management must show greater appreciation of engineers.
6. Workers must be allowed more participation in staff decisions that affect their work.
7. Better communication with supervisors and other departments is essential.

Copies of the "Report of the Survey of Attitude of Scientists and Engineers in Government and Industry" are available from the Superintendent of Public Documents, Government Printing Office, Washington 25, D. C., at 50 cents apiece.

Community or junior colleges where students can live at home while taking pre-engineering or technician courses are a most important manpower source. As an example, a New York City School now offers a two-year terminal course in Construction Technology that includes construction surveying, steel and concrete drafting and design, as well as general subjects.

In organizations doing research the usual practice is to reimburse all or at least part of money spent by an employee on furthering his education. And some larger companies have regular training programs leading to a place in management.

John R. Suman Wins John Fritz Medal

As announced in the November issue, John R. Suman, former vice-president and director of the Humble Oil and Refining Company and of the Standard Oil Company of New Jersey, is the 1958 recipient of the John Fritz Medal, one of the profession's most distinguished honors. An honorary member and former president of the AIME, Mr. Suman has had an outstanding career in petroleum engineering. Since his retirement from Standard Oil of New Jersey in 1955, he has been in consulting practice in Houston.

John Suman

The citation accompanying Mr. Suman's award hails him as a "pioneer in the application of engineering principles to the development, production, and conservation of petroleum and natural gas; author; industrial statesman; and one who takes a keen interest and real pleasure in inspiring men to make the most of their talents." Presentation of the medal to him will take place at the AIME annual banquet in New York on the evening of February 19.

A joint award of the four Founder Societies, the John Fritz Medal was established in 1902 by friends and associates of the late John Fritz, famous ironmaster, to perpetuate the memory of his contributions to industrial progress. It recognizes "notable scientific or industrial achievement." Previous recipients include Ralph Budd, Vannevar Bush, Benjamin F. Fairless, Charles F. Kettering, Ben Moreell, and Philip Sporn.

Competitive Bidding "Incidents" Decline

A study of Society headquarters records has disclosed a gratifying reduction in the number of instances of alleged competitive bidding on a price basis for professional engineering services. Such practice is held to be in conflict with Article 4 of the ASCE Code of Ethics, which provides that it is unprofessional to extend or respond to an invitation for proposals for engineering services "when there are reasonable grounds for belief that price will be the prime consideration in the selection of the engineer."

Thirty competitive bidding "incidents" came to the attention of the Society in 1955, and twenty-seven in 1956. The first ten months of 1957 brought only seven cases, and but two of them appear to be of serious nature. There is cause for considerable satisfaction in these figures, which may reflect tangible results of the Society's persistent efforts to encourage the selection of engineers on the basis of their reputation and proved performance instead of price alone.

One 1956 case required professional conduct action by the Board of Direction at its October 1957 meeting. Disciplinary action was taken against two members of the Society who had submitted quotations under circumstances which were held to be in violation of the Code. Several other cases are currently under active study by the Committee on Professional Conduct.

Because of the enormous potential demand for consulting engineering services in the current highway program, special steps were taken in September 1957 to urge state officials to exercise care in the selection of outside engineers. Copies of the Society's bulletin, "Negotiated Engineering Contracts Are in the Public Interest," were broadly distributed with an explanatory letter of transmittal. Responses from state officials indicate an overwhelming awareness of the fallacy of competitive bidding procedures, as well as solid endorsement of the procedural recommendations of the Society.

Headquarters emphasis has been on preventive advice and education rather than enforcement, except in flagrant cases. The record appears to justify this policy in full measure.

Total Membership as of November 8, 1957

Members	9,761
Associate Members	13,222
Junior Members	17,688
Affiliates	75
Honorary Members	46
Total	40,792
(Nov. 9, 1956	39,514)

1957 Nuclear Congress Papers Are Available

It is still possible to purchase separate copies of the papers presented at the 1957 Nuclear Congress, which was held in Philadelphia last spring. Copies, priced at 30 cents apiece, may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Separate copies will not be available after January 15, 1958.

Papers of special interest and usefulness to civil engineers are listed here. Please order by paper number only; otherwise, it will be necessary to return the order.

Coolants

57—NESC-76 Gas Coolant for Nuclear Reactors, by Michael Silverberg

57—NESC-80 Use of Boiling Water as a Reactor Coolant, by S. Untermeyer

57—NESC-104 UO_2-NaK Slurry Studies in Loops at 600 C, by B. M. Abraham, H. E. Flotow, and R. D. Carlson

57—NESC-113 Heat Transfer Considerations in the Use of Organic Reactor Coolants, by T. T. Shimazaki and W. F. Anderson

57—NESC-115 Design and Development of the Coolant System for the Sodium Reactor Experiment, by D. T. Eggen, A. M. Stelle, and M. Heisler

Educational Use of Reactors

57—NESC-73 Educational Uses of the Small 5-Watt Laboratory Reactor, by John W. Flora

57—NESC-74 Reactor Experiments in Orsort, by Herbert Pomerance

57—NESC-75 The Argonaut Reactor, by R. H. Armstrong, C. N. Kelber, D. H. Lennox, and B. T. Spinrad

57—NESC-85 The Water Boiler as an Instructional Tool, by Clifford K. Beck

57—NESC-105 Educational Uses of the Pickle-Barrel, by Richard Stephenson

57—NESC-110 A Portable, Polyethylene-Moderated, Training and Research Reactor (The AGN 201), by Arthur T. Biehl, Richard A. Faygram, Marion M. Harvey, Gustave A. Linenberger, John D. Randall, and Martin C. Reder

57—NESC-112 The Thermal Test Reactor and its Applications, by H. B. Stewart, G. B. Gavin, and R. E. Slovacek

Protection of Water Supplies

57—NESC-21 Stream Surveys for Radioactive Waste Control, by E. C. Tsivoglou, E. D. Harward, and W. Marcus Ingram

57—NESC-87 Radioactive Tracers in the Field of Sanitary Engineering, by Conrad P. Straub and G. Richard Hagee

57—NESC-88 Radiochemical Procedures for the Identification of the More Hazardous Nuclides, by Bernd Kahn and Abraham S. Goldin

Shielding and Control of Fission Products

57—NESC-17 The Application of Radioisotopes to the Measurement of Soil Moisture Content and Density, by Paul F. Carlton

57—NESC-18 Structural Features of the Waste Disposal System of the Shippingport Atomic Power Station, Shippingport, Pennsylvania, by H. T. Evans

57—NESC-51 Materials of Biological Shielding, by H. M. Glen

57—NESC-107 Control of Radioactive Material at the Pressurized Water Reactor, by J. R. Lapointe and R. D. Brown

Waste Disposal

57—NESC-1 Atomic Waste Disposal by Injection into Aquifers, by E. Roedder

57—NESC-53 Separation of Cesium and Strontium from Calcined Metal Oxides as a Process in Disposal of High Level Wastes, by A. Abriss, J. J. Reilly, and E. J. Tuthill

57—NESC-54 Disposal of Fission Products in Glass, by Raymond W. Durham

57—NESC-92 Problems Facing State Agencies in Handling Treatment and Disposal of Radioactive Wastes, by Emil C. Jensen, E. F. Eldridge, C. M. Everts, Jr. and H. C. Clare

Papers from the First Nuclear Engineering and Science Congress, held in Cleveland in December 1955, are also available from the ASME Order Department. The 87 papers provide detailed information on important researches and investigations made in government laboratories and by industrial organizations under contracts with the Atomic Energy Commission. They have been published in two fully illustrated volumes, priced at $17.50 a volume.

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES:	*1958 contest closes May 1, 1958. See 1956 Official Register, page 132; July 1957 issue of CIVIL ENGINEERING, page 72.*
FREEMAN FELLOWSHIP:	*1958-1959 award closes May 1, 1958. See Official Register, page 142.*
J. WALDO SMITH HYDRAULIC FELLOWSHIP:	*1958-1959 award closes May 1, 1958. See Official Register, page 143.*

Discussion of Proceedings Paper Is Extended

Proceedings Paper 1007 entitled "Friction Measurements in Apalachia Tunnel," by Rex A. Elder, supplements a paper entitled "Friction Coefficients in a Large Tunnel" by G. H. Hickox, A. J. Peterka, and R. A. Elder which was published as Paper No. 2353 in Vol. 113 of Transactions (1948).

The discussion period for Proceedings Paper 1007 has been extended to February 1, 1957. Free copies of this paper may be obtained by writing to ASCE Headquarters, 33 West 39th Street, New York 18, N. Y.

Alfred Noble Prize Goes To Mechanical Engineer

This year's winner of the Alfred Noble Prize is Ray D. Bowerman, a young mechanical engineer of Buena Park, Calif. Despite his youth, Mr. Bowerman has published four papers dealing with pump performance and design in the Transactions of ASME. His prize-winning paper, entitled "The Design of Axial Flow Pumps," appeared in Volume 78 (November 1956). The award, consisting of $400 in cash and a certificate, will be presented to him during the winter meeting of the ASME, to be held in New York this December.

A native of California, Mr. Bowerman entered California Institute of Technology in 1947 and continued there as student and research engineer until 1956. He holds B.S. and M.S. degrees in mechanical engineering and also the professional degree of mechanical engineer. It was during his employment in the Caltech Hydrodynamics Laboratory that he did the theoretical and experimental research on hydraulic machinery reported in his Transactions papers. Mr. Bowerman entered industry in 1956 with the U.S. Industries Research and Development Corp. and the Axelson Division of U.S. Industries. Since February 1957 he has been with the Task Corporation of Anaheim, Calif., engaged in engineering development in the fields of aerophysics research and aircraft electromechanical devices.

The Alfred Noble Prize is a joint annual award of the four Founder Societies and the Western Society of Engineers under the administration of ASCE. It was established in 1929 in honor of the late Alfred Noble, one-time president of ASCE and of the Western Society of Engineers.

Board Confirms New ASCE Committee Personnel

The 1958 Board of Direction, at its meeting in New York in October, confirmed appointment of ASCE committee personnel for the coming year. The committees of the Board follow (all terms expire in October 1958).

Executive Committee: Louis R. Howson, chairman; Samuel B. Morris, Waldo G. Bowman, Francis S. Friel, Norman R. Moore, Mason G. Lockwood, and Enoch R. Needles.

Honorary Membership: Louis R. Howson, chairman; Samuel B. Morris, Waldo G. Bowman, Francis S. Friel, Norman R. Moore, Mason G. Lockwood, and Enoch R. Needles.

Districts and Zones: Francis S. Friel, chairman; Samuel B. Morris, vice-chairman; and Norman R. Moore and Waldo G. Bowman.

Professional Conduct: Clinton D. Hanover, Jr., chairman; William J. Hedley, vice-chairman; Mason C. Prichard, Louis E. Rydell, Craig P. Hazelet, and John E. Rinne.

Meetings: Francis S. Friel, chairman; Samuel B. Morris, vice-chairman; and Norman R. Moore and Waldo G. Bowman.

Publications: Howard F. Peckworth, chairman; Philip C. Rutledge, vice-chairman; Tilton E. Shelburne, R. Robinson Rowe, Louis E. Rydell, and E. Leland Durkee.

Membership Qualifications: Mason C. Prichard, chairman; Randle B. Alexander, vice-chairman; Clarence L. Eckel, John P. Riley, Weston S. Evans, and Donald H. Mattern.

Division Activities: Francis S. Friel, chairman; Samuel B. Morris, vice-chairman; Finley B. Laverty, Robert H. Sherlock, Howard F. Peckworth (Chmn., Publication); Elmer K. Timby (Chmn., Research); and Clarence A. Willson (Chmn., Standards).

Conditions of Practice Executive Committee: Norman R. Moore, chairman; Waldo G. Bowman, vice-chairman; Finley B. Laverty, Clarence L. Eckel, Carey H. Brown, R. Robinson Rowe, E. Leland Durkee, Donald H. Mattern, Tilton E. Shelburne, Philip C. Rutledge, and Craig P. Hazelet.

The Auxiliary Administrative Committees will be:

Annual Convention: John P. Riley, Board contact member (1958).

Application Classification: Albert Haertlein, chairman (1959); William J. Shea, vice-chairman (1960); Harold L. Blakeslee (1958); and John P. Riley, contact member (1958). Alternates: Van Tuyl Boughton (1958); Oliver W. Hartwell (1958); and Leslie G. Holleran (1958).

Budget (Terms expire October 1958): Francis S. Friel, chairman; Howard F. Peckworth and William J. Shea.

Securities (Terms expire October 1958): George W. Burpee, chairman; David G. Baillie, Jr., and Clinton D. Hanover, contact member.

Voluntary Fund: R. Robinson Rowe, chairman; Robert H. Sherlock, Weston S. Evans, and John E. Rinne.

The new Professional Committees are:

Junior Members: Frank W. Edwards, chairman (1959); Nomer Gray, vice-chairman (1960); Trent R. Dames (1958); John E. Heinzerling (1961); and Finley B. Laverty, contact member (1958).

Local Sections: John C. Voorhees, chairman (1959); John C. Mirgain, vice-chairman (1960); Elmer J. Maggi (1958); John R. Campbell (1961); and E. Leland Durkee, contact member (1958).

Student Chapters: Charles E. Clarridge, chairman (1958); Lauress L. Wise, vice-chairman (1960); Emory E. Johnson (1959); Ray K. Chalfant, Jr. (1961); Thomas E. Stelson (1962); and Clarence L. Eckel, contact member (1958).

Engineering Education: Mercel J. Shelton, chairman (1959); Jack E. McKee, vice-chairman (1960); Roland P. Davis (1958); Edwin H. Gaylord (1959); Clarence H. Ax (1958); Elmer K. Timby (1960); William P. Kimball (1961); Alfred R. Golze (1961); and Carey H. Brown, contact member (1958).

Registration of Engineers: Daniel C. Walser, chairman (1959); John C. Park, vice-chairman (1960); David G. Baillie, Jr. (1958); George W. Bradshaw (1961); and Philip C. Rutledge, contact member (1958).

Professional Practice: Lloyd D. Knapp, chairman (1959); James A. Cotton, vice-chairman (1960); John W. Frazier (1958); Gustav J. Requardt (1959); William W. Moore (1960); Herbert C. Gee

(1958); Fred H. Paulson (1961); Emil H. Praeger (1961); and Craig P. Hazelet, contact member (1958).

Salaries: Warren W. Parks, chairman (1959); Oscar S. Bray, vice-chairman (1960); William J. Carroll (1961); Harold W. Morgan (1958); and Tilton E. Shelburne, contact member (1958).

Employment Conditions: Charles W. Griffin, Jr., chairman (1959); R. Earl Salveter, vice-chairman (1960); Jack Y. Long (1958); Irving F. Ashworth (1961); and Donald H. Mattern, contact member (1958).

Engineers in Public Practice: Graham P. Willoughby, chairman (1959); Mercel J. Shelton, vice-chairman (1960); Frank L. Weaver (1961); Don M. Corbett (1960); Charles H. Capen (1958); Paul L. Weir (1959); Blucher A. Poole (1961); Simon W. Freese (1958); and R. Robinson Rowe, contact member (1958).

Appointments to the Technical Committees are as follows:

Research: Elmer K. Timby, chairman (1959); Arthur T. Ippen, vice-chairman (1960); Martin A. Mason (1958); Harold B. Gotaas (1961); and Randle B. Alexander, contact member (1958).

Technical Procedure (All terms expire October 1958): Francis S. Friel, chairman; Samuel B. Morris, vice-chairman; Robert H. Sherlock; Finley B. Laverty; Howard F. Peckworth (chairman, Committee on Publications); Elmer K. Timby (chairman, Committee on Research); Clarence A. Willson (chairman, Committee on Standards) and the respective chairmen of the Executive Committees of the Technical Divisions.

Standards: Clarence A. Willson, chairman; Mason C. Prichard, vice-chairman; Charles W. Bryan, Jr., and William S. La Londe, Jr.

The Technical Division contact members for 1957-1958 are:

Air Transport .. Clinton D. Hanover, Jr.
City Planning ..... William J. Hedley
Construction ..... Mason C. Prichard
Engineering Mechanics
Robert H. Sherlock
Highway ..... R. Robinson Rowe
Hydraulics ..... Louis E. Rydell
Irrigation and Drainage
Finley B. Laverty
Pipeline ..... John E. Rinne
Power ..... Donald H. Mattern
Sanitary Engineering
Howard F. Peckworth
Soil Mechanics and Foundations
Randle B. Alexander
Structural ..... E. Leland Durkee
Surveying and Mapping
Weston S. Evans
Waterways and Harbors
Carey H. Brown

New appointments to the Task Committees follow:

Advisory on EJC Water Policy Panel: Louis R. Howson, chairman; Wallace L. Chadwick, vice-chairman; and George W. McAlpin, I. C. Steele, Mercel J. Shelton, and Norman R. Moore, contact member.

George Washington Memorials: U. S. Grant, III, chairman; Carl G. Paulsen, vice-chairman; and Daniel C. Walser, Frank L. Weaver, and Mason C. Prichard, contact member.

Professional Education: Adolph J. Ackerman, chairman; and Harvey O. Banks, Frederick B. Farquharson, Nathan M. Newmark, John B. Wilbur, Kirby Smith, and Carey H. Brown, contact member.

Convention Policy and Practice: Daniel V. Terrell, chairman; Glenn W. Holcomb, Francis S. Friel, William J. Hedley, and John P. Riley, contact member.

Subcommittee on Exhibits: Philip C. Rutledge, chairman; Renville S. Rankin, William S. Foster, and Brice R. Smith.

Professional Development: James M. Morgan, Jr., chairman; and Nomer Gray, Edwin H. Gaylord, Jr., Lauress L. Wise, and Clarence L. Eckel, contact member.

Awards Policy: Howard F. Peckworth, chairman; and N. A. Christensen and Leslie G. Holleran.

Classification of Members: Frank L. Weaver, chairman; and Randle B. Alexander, Don M. Corbett, Clarence L. Eckel, William S. La Londe, Jr., Mason C. Prichard, John P. Riley, Thomas C. Shedd, Lowber D. Snow, and Graham P. Willoughby.

Principles of Practice: N. T. Veatch, chairman; and Ernest W. Carlton, Burton G. Dwyre, Frederick H. Paulson, and Louis R. Howson, contact member.

Water Resources: W. W. Horner, chairman; and Joseph B. Tiffany, Warren E. Darrow, Andrew P. Rollins, Sr., Louis S. Bernstein, Lewis C. Coxe, and Carey H. Brown, contact member.

Cost Allocation for Multiple-Purpose Water Projects: F. W. Scheidenhelm, chairman; and W. W. Horner, Royce J. Tipton, and Martin W. Torkelson.

Administrative Procedure: Lawrence A. Elsener, chairman; and Graham P. Willoughby, George S. Richardson, and G. Brooks Earnest.

New appointments to the Joint Committees follow:

ASCE-AGC Joint Cooperative (Terms expire October 1958); Charles B. Molineaux, chairman; and Charles M. Davis, Arthur E. Poole, William W. Wanamaker, Thomas C. Shedd, and Clinton D. Hanover, Jr., contact member.

ASCE-AIA Joint Cooperative (Terms expire October 1958): G. Brooks Earnest, chairman; and Charles H. Topping, Joseph H. Ehlers, W. O. Hiltabidle, and William J. Hedley, contact member.

ASCE-AASHO Joint Cooperative (Task): Harmer E. Davis, co-chairman; and J. Paul Buckley, Archie N. Carter, William A. McWilliams, Earle V. Miller, and R. Robinson Rowe, contact member.

ASCE-AWWA Committee on Spillways (Task): Francis B. Slichter, Chesley J. Posey, Raymond A. Hill, and Louis E. Rydell, contact member.

Engineers Council for Professional Development: Clarence H. Ax (Oct. 1960); Harold E. Wessman (Oct. 1958); Weston S. Evans (Oct. 1959); and Robert H. Sherlock, contact member (Oct. 1958).

United Engineering Trustees: C. B. Molineaux (Oct. 1958); D. V. Terrell (Oct. 1959); and G. W. Burpee (Oct. 1960).

Engineers Joint Council: *Representatives* **(2-year term)** Carlton S. Proctor (Jan. 1959); Enoch R. Needles (Jan. 1959); Samuel B. Morris (Jan. 1960); and William H. Wisely (Jan. 1960). *Alternates* (Term expires Jan. 1959): Frederick H. Paulson, William N. Carey, G. Brooks Earnest, and Jewell M. Garrelts. Louis M. Howson, ex-officio.

The Engineering Foundation: Charles B. Molineaux (1960) Trustee Rep.; Elmer K. Timby (1958); Leslie G. Holleran (1959); and Carlton S. Proctor (1959), member-at-large.

American Association for the Advancement of Science (Terms expire Dec. 31—3-year term): Thorndike Saville (1960), and Waldo E. Smith (1958).

Engineering Societies Library Board: Harold M. Lewis (Oct. 1958), and Walter E. Jessup (Oct. 1960).

National Research Council: Frederic T. Mavis (June 1958), Division of Engineering and Industrial Research; and Harold J. McKeever (June 1958), Highway Research Board.

New appointees to the Committees on Society Prizes and Awards follow:

Ernest E. Howard Award: Louis R. Howson, chairman, Charles D. Riddle, Warren Raeder.

J. Waldo Smith Hydraulic Fellowship: James M. Robertson, chairman (1958); Samuel B. Morris (1959).

Freeman Fund: Ralph W. Powell, chairman; John K. Vennard, Lorenz G. Straub, Martin A. Mason, and George H. Hickox.

Society Prizes: James R. Sims, chairman; Charles L. Barker, and Gayle McFadden.

Subcommittee on the Alfred Noble Prize .(All terms to Oct. 1958): Ernest W. Carlton, Thomas C. Shedd, and Anthony de H. Hoadley.

Appointees to joint representation with other organizations are:

Anson Marston Medal Board of Award (3 year term): Samuel A. Greeley (June 1958).

John Fritz Medal Board of Award: Daniel V. Terrell (Oct. 1958); Wm. Roy Glidden (Oct. 1959); Enoch R. Needles (Oct. 1960); Mason G. Lockwood (Oct. 1961). *Alternates:* Howard T. Critchlow (Oct. 1958); Harold L. Blakeslee (Oct. 1959); William S. La Londe, Jr. (Oct. 1960); and Karl R. Kennison (Oct. 1961).

Washington Award Commission: Charles H. Mottier (May 1958); John F. Seifried (May 1959).

Hoover Medal Board of Award: Malcolm Pirnie (May 1958); Carlton S. Proctor (May 1960); Leslie G. Holleran (May 1962). *Alternates:* Francis S. Friel (May 1958); George W. Burpee (May 1960); and Richard E. Dougherty (May 1962).

Charles Franklin Kettering Board of Award: William Roy Glidden (Oct. 1959); Carl B. Jansen (Oct. 1961).

Alfred Noble Joint Prize Committee: Louis E. Ayres, chairman (Dec. 1961). *Alternate:* William S. La Londe, Jr. (Dec. 1961).

Division Doings

Hydraulics Division Charts Program

For 1958 the Hydraulics Division has grand plans for serving its 4,000 members. These plans were shaped up at a recent meeting of the Division's executive committee in Chicago. The Chicago session reviewed the programs of some 27 committees, 17 forthcoming technical sessions, and a variety of publications.

The technical sessions will be presented during the three 1958 ASCE Conventions and at a Division conference, scheduled for the Georgia Tech campus in Atlanta, August 20-22. For all four conferences, programs so vital to the practice of hydraulics are being offered that members cannot afford to stay away.

New committee assignments were also passed out during the Chicago session. The Division will have a new Committee on Hydromechanics, a new Committee on Hydraulic Structures, a new Flood Control Committee, and a new Research Committee (with the old title but new functions).

The Division reports it has found that such meetings as the Chicago session, held soon after the start of a new fiscal year and at a central location, yield dividends in the form of more energetic administration of Division activities. Division officers attending the planning session were Harold M. Martin, chairman; Carl E. Kindsvater, vice-chairman; Wallace M. Lansford, former chairman; and Arthur T. Ippen and Joseph B. Tiffany.

Sanitary Engineering Division Lauds Earnest Boyce

The Sanitary Engineering Division's executive committee has passed a resolution of appreciation of the "faithful and exceptional service" Earnest Boyce has rendered the Division as chairman for the past six years of the Joint Committee for the Advancement of Sanitary Engineering. Professor Boyce is also commended as "the first chairman of the American Sanitary Engineering Intersociety Board during the formative period of this Board and the certification of the initial roster of sanitary engineers."

Waterways and Harbors Conference

Some 130 Annual Convention visitors made the trip to Princeton, on October 18, for the Waterways and Harbors Conference held at Princeton University under sponsorship of the Waterways and Harbors Division. Four technical papers dealing with the planning and design of port and harbor works were presented by members of the staff of the Port of New York Authority and the Princeton faculty. One of the conference highlights was the luncheon at the Princeton Inn, addressed by Dr. James D. Brown, dean of the Princeton faculty. Dr. Brown discussed the utilization of engineers to maximum good effect in government and industry.

New Highway Division Committee

The Highway Division announces that its Committee on Increasing Highway Engineering Productivity is completely organized. Heading the highly important and widely representative new group is L. R. Schureman, chief of the Electronics Branch of the Bureau of Public Roads' Division of Development, Washington, D. C. The others are John J. Kozak, senior bridge engineer for the California Division of Highways, Sacramento; Reed H. Winslow, special assignment engineer for the Automotive Safety Foundation, Washington, D. C.; J. C. Robbers, assistant state highway engineer, Minnesota Department of Highways, St. Paul; James W. Conlon, of DeLeuw, Cather & Brill, New York City; R. Glen Ryden, chief computer for the Arizona Highway Department, Phoenix; and Ross G. Wilcox, of the Portland Cement Association's Highways and Municipal Bureau, Chicago.

ASCE QUARTERLY ENGINEERING SALARY INDEX

Consulting Firms

City	Current	Last Quarter
Atlanta	1.11	1.10
Baltimore	1.10	1.09
Boston	1.13	1.09
Chicago	1.12	1.12
Denver	1.14	1.11
Houston	1.08	1.04
Kansas City	1.11	1.08
Los Angeles	1.16	1.14
New Orleans	(insufficient returns)	
New York	1.17	1.15
Pittsburgh	0.91	1.05
Portland	1.15	1.08
San Francisco	1.21	1.15
Seattle	1.07	1.05

Highway Departments

Region	Current	Last Quarter
I, New England	0.88	0.84
II, Mid. Atlantic	1.12	1.10
III, Mid. West	1.19	1.16
IV, South	1.05	1.04
V, West	0.96	0.96
VI, Far West	1.12	1.06

Figures are based on salaries in effect as of Aug. 15, 1957.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

The "drawing card" at a recent meeting of the **Savannah Branch, Georgia Section,** was Section President Burton J. Bell. Mr. Bell gave an illustrated talk on water problems of the southeastern United States, and the activities of the Corps of Engineers in the area as related to those problems.

Members of the **Kansas Section** were out of this world at their recent meeting. The excitement was caused by Richard Holloway, speaker of the evening, who discussed satellites and rockets. Mr. Holloway exhibited a model of the three-stage Vanguard rocket that is to be used to launch earth satellites during the International Geophysical Year. He described the rockets, their launching and tracking, and compared the Russians' progress to our own. The evening ended with an animated discussion from the floor.

Problems faced by Maryland in its highway and bridge construction programs, and their proposed solutions were discussed at the October meeting of the **Maryland Section.** Robert O. Bonnell, chairman of the Maryland State Roads Commission, was the speaker of the evening. His informed talk prompted a long and lively discussion period.

Junior Activities Committee of Kansas City Section sponsors panel discussion of "Human Engineering," dealing with the engineer's place in the community. Shown here in usual order are R. J. Leininger, J. C. Rowland, J. G. Stinson, R. E. Vansant (chairman), G. B. White, Charles Wolfe, and R. C. Bergendoff.

President Mason Lockwood enjoys the hospitality of the Mexico Section on visit to Mexico City. Shown here, from left to right, are Jose Vincente Orozco, vice-president; Miguel Montes de Oca, secretary-treasurer; Leopoldo Farias S., president; President Lockwood; Lorenzo Perez Castro, past-president and recently elected Honorary Member; Francisco Gomez Perez; Julio Colon, president Mexico Section AIEE; and Gregorio Solis Payan, past-president, Mexico Section, AIEE.

Prof. G. B. Pickett, member of the department of mechanics at the University of Wisconsin's College of Engineering, shared his "Engineering Experiences in India" with members of the **Mid-South Section's Vicksburg Branch,** at a recent meeting. Professor Pickett has been at the University of India under the Point-Four program for the past two years. The **Little Rock Branch** was host to W. C. Koch, engineer for the Southwestern Bell Telephone Co., at a recent meeting. Mr. Koch presented an informative talk and film on "Transistors and Their Uses."

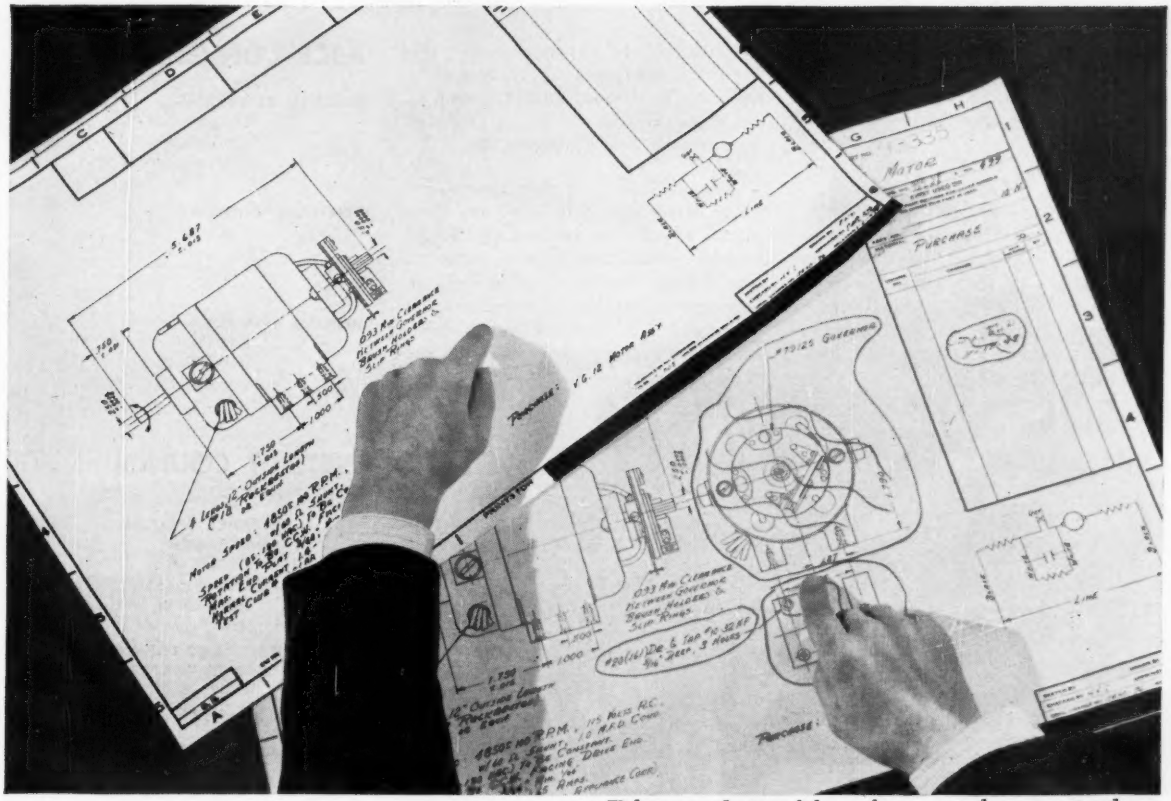
High point of a recent **Nashville Section** meeting was a talk on "Law and the Engineer," presented by Carmack Cochran, Nashville attorney. Mr. Cochran discussed the engineer's legal obligation under contract, and his ethical responsibility. The well-chosen topic was of great interest to members.

"Earth's Space Satellites" was the pertinent and revealing talk presented to **National Capital Section** members at a recent meeting. Guest speaker Edmond J. Habib, head of the Calibration Section of the Naval Research Laboratory, dealing with "Operation Vanguard," reviewed the development of the United States space satellite and revealed many of the details regarding its anticipated performance. A scale model of the satellite and the three-stage launching rocket was exhibited, and their operation demonstrated. The exciting speech prompted an enthusiastic discussion from the floor.

The engineer's part in the reactivated (1954) interstate highway plan was discussed by Gen. L. W. Prentiss, executive vice-president of the American Road Builders Association, at a recent **Nebraska Section** meeting. General Prentiss summarized the methods considered for financing the system, current legislation, and bills that will be presented to congress at the next session. An animated question-and-answer period followed.

Armco steel's history and development were outlined to members of the **Sacramento Section's** Marysville Branch at a recent meeting. Max Bailey, sales manager for the Calco Division of Armco Drainage and Metal Products, Inc., was featured speaker.

With the guidance of Phil Noble, resident engineer on the Wahluke Siphon, members of the **Spokane Section** and the



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TRADEMARK

Columbia Section explored the Columbia Basin Project. An afternoon tour and discussion of Priest Rapids Dam was led by Bob Jackson, resident engineer for Harza Engineers.

"Unique Features of Recent Construction at McDonnell Aircraft" were spotlighted at a recent **St. Louis Section** meeting, when G. C. Schweser, chief of the Construction Engineering Department at the McDonnell Aircraft Corporation, presented an informative, illustrated talk on the subject.

"Magic Metal Lithium" was the subject of an interesting talk presented to members of the **San Antonio Branch** of the **Texas Section** by G. T. Deck, of American Lithium Chemicals, Inc.

"Rehabilitation of the government bridge between Arsenal Island and Davenport, Iowa," was discussed by Harold Eckhoff, of Modjeski-Masters, at a recent **Tri-City Section** meeting held in Davenport, Iowa. The informed talk, accompanied by excellent color slides, made the evening both valuable and entertaining.

High point of the North Carolina Section's annual meeting (November issue, page 92) was the election of new officers. They are (left to right) C. R. McCullough, secretary-treasurer; W. F. Babcock, vice-president; T. P. Noe, vice-president; and L. E. Wooten, Sr., president.

South Carolina Section members show President Mason Lockwood (second from right) work at the Atlantic Fleet Mine Force's new base at the Charleston Naval Base. Mr. Lockwood, guest of the Section at a luncheon, also visited the Citadel and was received by General Mark W. Clark, Citadel President.

ASCE CONVENTIONS

CHICAGO CONVENTION
Chicago, Ill.
Sherman Hotel
February 24-28, 1958

PORTLAND CONVENTION
Portland, Ore.
Multnomah Hotel
June 23-27, 1958

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 13-17, 1958

DISTRICT COUNCIL MEETINGS

DISTRICT 9 COUNCIL CONFERENCE
Akron, Ohio
Sheraton-Mayflower
April 18-19, 1958

PACIFIC SOUTHWEST COUNCIL CONFERENCE
Phoenix, Ariz.
April 17-19, 1958

LOCAL SECTION MEETINGS

Cleveland—Dinner meeting at the Cleveland Engineering Society headquarters, December 13, at 6:30 p.m.

Georgia—Savannah Branch dinner meeting at the Neptunalia Restaurant, Savannah, Ga., December 11 at 6 p.m.

Illinois—Luncheon meeting at the Chicago Engineers Club every Friday. Annual dinner meeting at the Sherman Hotel, Chicago, Ill., December 12.

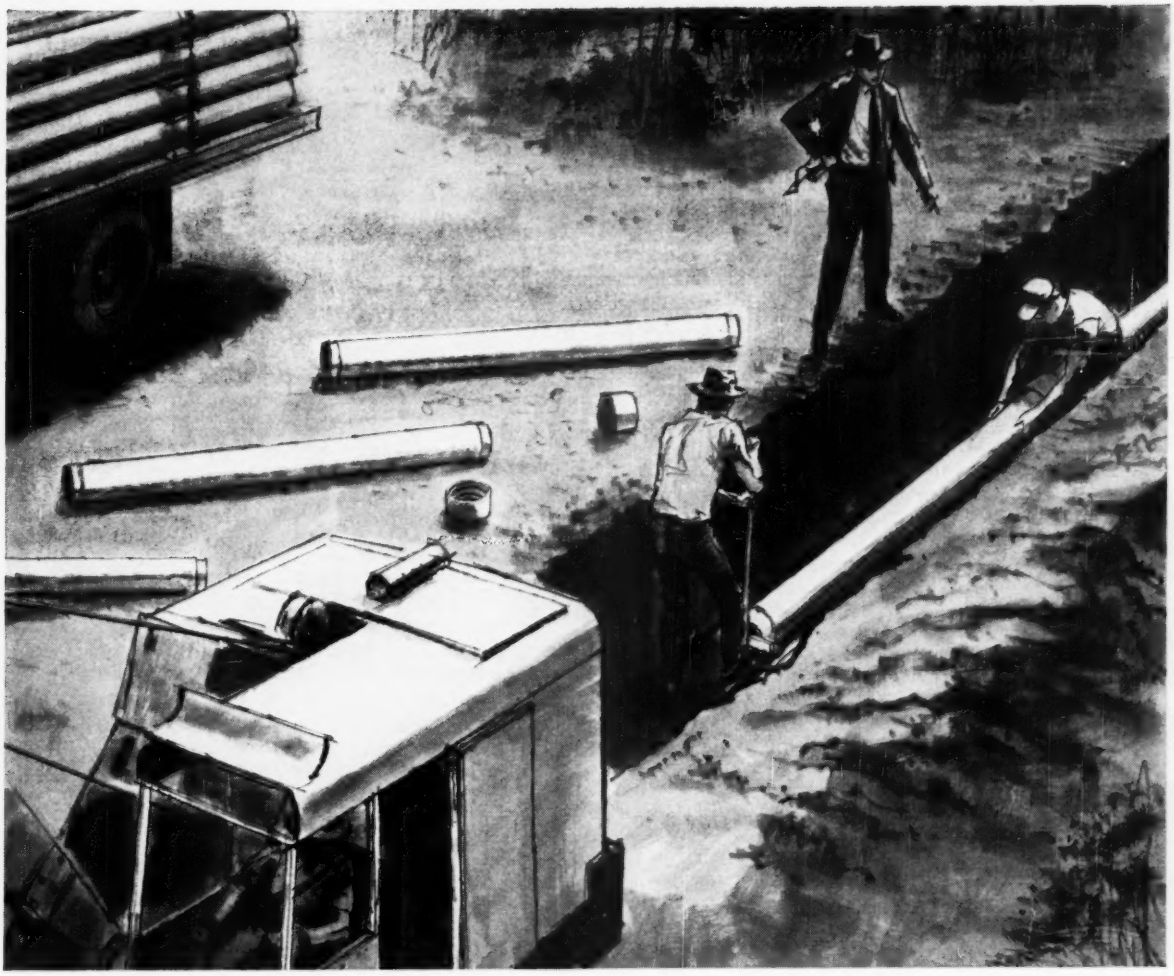
Lehigh Valley—Annual dinner meeting at Walp's Restaurant, Allentown, Pa., December 18, at 6:30 p.m.

Los Angeles—General dinner meeting at Rodger Young Auditorium, Los Angeles, Calif., December 11, at 6:30 p.m. Santa Barbara-Ventura Counties Branch dinner meeting, at Marine Room, Pierpont Inn, Ventura, Calif., December 17, at 6:30 p.m.

Metropolitan—Meeting in the Engineering Societies Building, December 18, 7 p.m.

Sacramento—Annual Christmas Jinx luncheon at the Elks Club, Sacramento, Calif., December 17, at 11:30 a.m. Luncheon meetings every Tuesday in January, at the Elks Club.

Tennessee Valley—Knoxville Branch dinner meeting at the S&W Cafeteria, Knoxville, Tenn., January 8, at 5:30 p.m.



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BY-LINE WASHINGTON . . . . .

Nineteen states received chunks of the newest designation of Interstate System routes last month when the Bureau of Public Roads announced the 2,105 miles it will add to the system. With this latest addition, the full 41,000 miles has been completely assigned. These are the highways on which Uncle Sam will bear 90 percent of the cost, and their allocation has been eagerly awaited.

Congress authorized the Bureau to assign an additional 1,000 miles to the network many months ago. After receiving final locations for the original 40,000 miles, the BPR found that "short-cuts" would produce another 1,105 miles. This welcome windfall is expected to take some of the steam out of the mass push for additions to the superhighway system. Requests from the state highway departments totaled about 13,000 miles, and there was considerable congressional pressure for pet projects.

* * *

A new guide to public works planning has been released by a White House staff under Gen. John S. Bragdon, coupled to an appeal that state and municipal officials lift their sights to the onrushing demands of the years just ahead. The general's unit—composed of an engineer, an economist, a financial specialist, a water resources expert and others—was set up to give President Eisenhower expert counsel on the public works needs of the nation and the effect of proposed construction on the national economy.

Some $20‡ billion worth of public works construction should be undertaken during the next ten years to meet the population and industry demands of the next decade, the Administration advisers reported. These needs can be met only if responsible officials take action steps to plan and then program the necessary construction. (The nation is already behind some $130 billion worth of schools, sewage treatment plants, highways, hospitals, and other public works. During the next ten years, construction of $20 billion worth of such facilities must be undertaken to replace those falling out of service. And the foreseeable increase in population and expansion of industry will require another $45 billion worth of new construction.)

State, city, and county officials today frequently plan independently—sometimes arbitrarily—without regard for the future plans of these overlapping jurisdictions. Even within the same governmental unit, school districts may plan their projects without reference to highway plans. More than 102,000 separate entities throughout the country are responsible for planning public works. Without some kind of cooperation and meshing of their plans, only waste can result, the federal advisers claim.

"We have to begin thinking about comprehensive planning," one official declared, "instead of on a project-by-project basis." And comprehensive planning means not only long-range planning, but planning that is coordinated between the city, the state and the country, and within the city, the state, and the country."

Such systematic planning frequently produces remarkable savings. The new report cites seven communities which estimate a saving of $116 million through modern planning. One state says it has saved over $300 million since 1952 through planned advance right-of-way acquisitioning. A large Southern city, by pre-planning and combining its financing, will save $400,000 over the life of a 20-year bond issue.

* * *

A step-by-step plan for the improvement of county road management has been issued by the newly formed National Association of County Engineers. Fostered by the National Association of County Officials and the Automotive Safety Foundation, the organization's avowed aim is to upgrade the engineering of rural roads under the jurisdiction of county governments. One basic objective is to encourage county officials to retain professional engineers to oversee their construction and maintenance operations, Bernard Hillenbrand, NACO executive secretary, reported.

* * *

Two federal-aid programs are making inroads into the nation's big backlog of badly needed water and sewage plants:

1. *Advance planning for $1 billion worth of water and sewage plant* construction is being significantly aided through a federal loan fund, the agency in charge told CIVIL ENGINEERING last month. Some 1,463 projects have been advanced in this way by the Community Facilities Administration of the Housing and Home Finance Agency. In some cases, construction funds have been loaned also.

2. *Meanwhile, the first eleven months of the new federal water pollution control* program, under which construction grants are being made for communities for sewage treatment works, has been eminently successful, federal officials believe. The first project approved for this kind of federal aid was given the go-ahead last December 6.

$54 million worth of grants has been OKed for construction in 662 communities since then. Local matching money will bring the total amount available for these projects to $266 million. As Congress expected, the program has proved immensely popular. Federal aid is limited to one-third of the construction cost or a maximum of $250,000.

Applications are flowing into Washington in a steady stream—at last count nearly 1,300 had been received, for money to start projects which will cost an estimated $787 million.

(In spite of this popularity, however, the water pollution control program is probably one of the most susceptible to criticism as a "pork-barrel give-away" scheme. It has figured prominently in the list of federal programs which, critics insist, should be turned back to the states and cities.)

Bethlehem High-Strength Bolts join structural members in new home of Chicago Sun-Times. *Owner:* Field Enterprises, Inc.; *Architects-Engineers:* Naess and Murphy; General Contractor: George A. Fuller Company.

Newsplant in Chicago has high-strength bolting

The new home of the Chicago Sun-Times is one of the most modern newspaper plants in the country. The aluminum curtain wall structure, on the north bank of the Chicago River, is nine stories high, and has a penthouse. Its total floor area is approximately ten acres.

The erection of the 6,400 tons of steel framework for this attractive building proceeded smoothly and quietly, using thousands of Bethlehem High-Strength Bolts to connect the structural members.

Bethlehem High-Strength Bolts save time in erecting steelwork because they can be installed quickly by means of a pneumatic impact wrench and holding wrench. Each bolt is used with two hardened washers, one placed under the head, the other under the nut. With this method, tight, sound joints are possible in a matter of seconds.

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NEWS BRIEFS . . .

House Names Advisers For Panama Canal Study

A special six-man technical staff has been appointed to advise the House Merchant Marine Committee in an inquiry into the adequacy of the Panama Canal. According to the committee chairman, Representative Herbert C. Bonner of North Carolina, the present canal is "approaching obsolescence." He said his committee has the "urgent responsibility" to be fully informed as to the adequacy of the existing canal in view of its increasing burden of traffic and the present world situation. He referred to the "lessons to be learned" from the temporary closing of the Suez Canal.

The technical advisory staff includes three members of the Society: Vice-President Francis S. Friel, consulting engineer of Philadelphia; S. C. Hollister, dean of engineering at Cornell University; and E. Sydney Randolph, of Baton Rouge, La., former long-time Canal Zone employee. Also named to the committee are Lt. Gen. Leslie R. Groves (Ret.), of Darien, Conn., who headed the wartime Manhattan Project, which developed the atom bomb; Hartley Rowe, of Boston, vice-president of the United Fruit Company; and John E. Slater, New York City consultant.

The advisory group will study the feasibility of enlarging the present canal or building a second canal in Central America. Before making its report, it will review previous studies of proposed routes and possible modifications of the present canal.

Two Contractors Receive Moles' Awards for 1958

Once again the Moles, New York society of leading figures in the tunnel and heavy construction industry, announce their annual awards "for outstanding achievement in construction." Named as 1958 recipients are Peter F. Connolly, of Osterville, Mass., and Francis Donaldson, of Bronxville, N. Y. Formal presentation of their honors will be made at the annual Moles Awards Dinner at the Waldorf-Astoria Hotel on January 29. The award, considered the highest recognition that can be accorded service to the American construction industry, goes annually to one member and one non-member of the Moles.

Peter Connolly

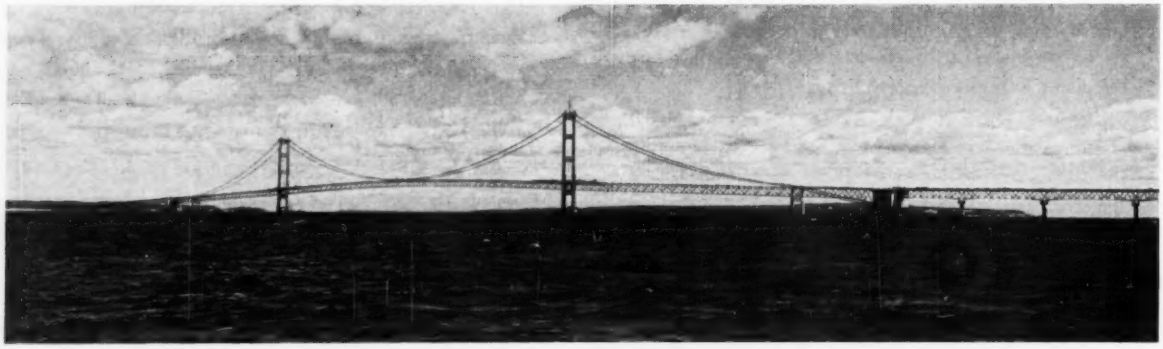
Francis Donaldson

Mr. Connolly, the member winner, is president of the Peter F. Connolly Co. He has been primarily concerned with tunnels and pneumatic caissons in a construction career that goes back to 1902 and work on the East Boston Tunnel. In business for himself since 1908, Mr. Connolly has been responsible for several important tunnels for the New York City Board of Water Supply—one of them a $44,000,000 contract in the early thirties. During World War II he was project manager for the joint-venture building of the Navy's Third Air Base in Trinidad.

Mr. Donaldson has been a vice-president and director of Mason & Hanger, a New York City construction firm, since 1936, but he had put in a full quarter of a century of distinguished construction service even before that date. One of his best known accomplishments was in designing braced open cofferdams that solved difficult foundation problems on the construction of the New Jersey towers for the George Washington Bridge. He has also done important work on the construction of the Lincoln Tunnel and the Brooklyn-Battery Tunnel.

Messrs. Connolly and Donaldson are the eighteenth pair of recipients in a series that started in 1941.

$100,000,000 Suspension Bridge Spans Mackinac Straits



New $100,000,000 Mackinac Straits Bridge, second longest suspension bridge in the world, was opened to traffic on November 1. The impressive structure features a 3,800-ft suspension span, exceeded in length only by the 4,200-ft span of the Golden Gate Bridge. Span and approaches, totaling over four miles in length, provide a speedy, all-weather connection between the upper and lower Michigan peninsulas. The terminal cities are Mackinaw City and St. Ignace. Tolls are $3.25 for automobiles (passengers included) and $14 for trucks—about the same as the rates for the now defunct ferry. D. B. Steinman, M. ASCE, New York City consultant and bridge authority, was the designer and engineer.

Throgs Neck Bridge Project Is Started

Ground was broken on October 22 for the six-lane Throgs Neck Bridge between the Bronx and Queens. The brief ceremonies, initiating the first stage of the $90,000,000 project, took place at the New York State Maritime College at Throgs Neck in the Bronx. Scheduled for completion in 1961, the project will provide badly needed relief for the crowded Bronx-Whitestone Bridge. It will also be a key structure in the city's arterial highway belt bypassing congested city areas.

The Throgs Neck Bridge will be 2,910 ft between anchorages, with a center suspended span of 1,800 ft and side spans of 555 ft. Both the bridge and its 1¾-mile viaduct approaches in the Bronx and Queens will be built and paid for by the Triborough Bridge and Tunnel Authority. The express highways leading to the structure will be part of the Interstate Highway System and will be built by the State Department of Public Works, with federal aid and without expense to the city.

The first stage of construction is being carried out by the Slattery Contracting Company, Inc., low bidders for the job of adding seven acres of new shorefront land to the property occupied by the college, in return for easements granted to the Bridge and Tunnel Authority for the Bronx approaches to the new span. Merritt-Chapman & Scott is low bidder (at $7,490,790) for construction of the foundations of the two main towers. Bethlehem Steel is low bidder (at $10,157,664) on construction of the superstructure of the towers, and the American Bridge Division of U. S. Steel (at $6,291,739) is low bidder on the main cables and suspenders.

Steel Shipments Are Near Record High

Shipments of finished steel products during the first nine months of this year totaled 62,589,328 tons—the second highest total for any comparable period—the American Iron and Steel Institute reports. The total is more than 1.7 million tons greater than the January-September shipment last year, and only about 83,000 tons less than the nine-month record set in 1955. September shipments totaled 6,171,674 net tons, down from August shipments of 6,229,853 tons and from September 1956 shipments of 7,058,028 tons.

The principal markets for shipments of finished steel products during the first nine months of the current year were warehouses and distributors (11,708,222 net tons); automotive (10,392,996 net tons); and construction, including maintenance (a record 9,637,526 net tons).

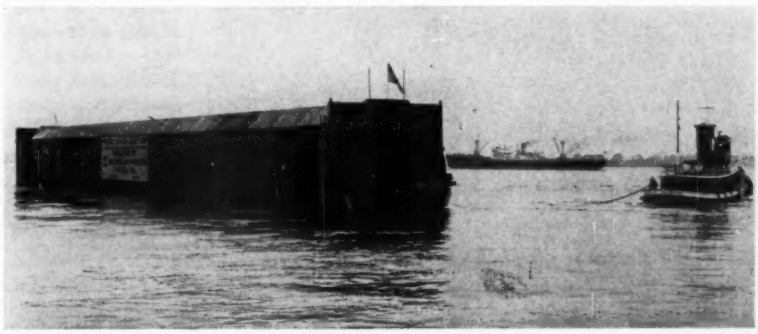
Hampton Roads Bridge-Tunnel Project Opened

The Hampton Roads Bridge-Tunnel, the first direct traffic link between Newport News and Hampton on the north side of Hampton Roads and Norfolk and Portsmouth to the south, was dedicated on November 1. Highlighting the opening ceremonies were addresses by the Hon. Thomas Stanley, governor of Virginia, and Highway Commissioner James A. Anderson, M. ASCE. The important 3½-mile expressway—consisting of a two-lane subaqueous tunnel, two low-level approach bridges, and two portal islands—is a key link in the Virginia Department of Highways' 27-mile road improvement program for the area. It was designed by Parsons, Brinckerhoff, Hall and Macdonald, and built by the Merritt-Chapman & Scott Corporation, both of New York City.

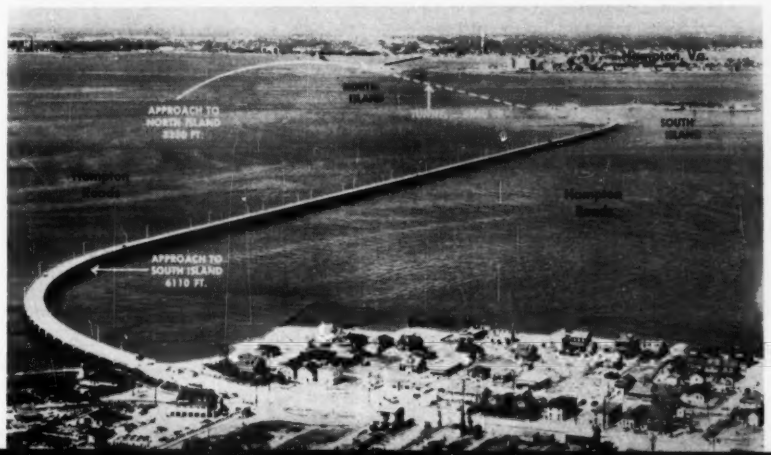
With a length of 6,860 ft, the tunnel is the world's sixth longest subaqueous crossing, and one of the thirteen trench-type tunnels in the world. It is made of twenty-three 300-ft-long sections of double-shell steel tube. The sections were fabricated and assembled, complete with inner webbing of reinforcing steel, at Eddystone, Pa., by the Baldwin-Lima-Hamilton Corp. under a subcontract. The sections were launched in the Delaware and then towed to a special "shape up" basin at Hampton Roads, 250 miles away, by way of the Delaware-Chesapeake Canal, Chesapeake Bay, and the Elizabeth River. After final fitting, the sections were sunk in a special trench prepared under Hampton Roads.

One approach bridge, 3,250 ft long, runs from Hampton to the island on the north side of the Roads; the other bridge, which is 6,110 ft in length, extends to an island off the southern shore. To form the two islands, an estimated 5,500,000 cu yd of material was dredged up from the bottom of Hampton Roads and used as fill. The islands (rectangular in shape) are 170 ft wide and 1,400 and 1,250 ft long. They rise to a height of about 11 ft above mean sea water and have protective seawalls formed of riprap.

One of the completed steel tubes, fitted with watertight bulkheads at both ends, is shown en route to the tunnel site. All 23 sections were launched from construction ways along the Delaware River at Eddystone, Pa., and towed to Hampton Roads, 250 miles away. Some 1,500 tons of concrete were placed between outer and inner shells to serve as ballast before tube was launched.



On this overall view of the 3½-mile-long Hampton Roads expressway project are indicated the two bridge approaches, the man-made portal islands, and the 6,860-ft trench-type subaqueous tunnel. By eliminating a ferry trip, the project cuts travel time between the north and south shores of Hampton Roads from 30 to 7 minutes.



Peace River Suspension Bridge Collapses

The Peace River Suspension Bridge, near the southerly end of the Alcan Highway in British Columbia, failed on October 16, when 800 to 900 ft of the north bank of the river slid about 12 ft toward the river, carrying with it the north anchorage and the supporting bent at the river end of the north truss span. The foundation material is glacial till, gravel and soft shale. The bridge had a 930-ft center span with 465-ft suspended side spans and a 135-ft truss span at each end just inside the anchorage.

The north supporting bent also was forced to tip by movement of the anchorage. The cable movement dropped the side span sufficiently so that impact tore loose the 2½-in.-dia cable suspenders. Beyond the north tower the deck was left standing, but towers and trusses are badly wracked. The top of the north tower is kinked about 10 ft to the south, although the foundation of it appears not to have moved.

The structure was designed by the U.S. Public Roads Administration and built in 1942 as a rush part of the Alcan Highway. At the time the substructure was built there was some question as to the adequacy of the foundation but the risk was taken to complete the structure for emergency war use. John A. Roeblings erected the superstructure, using 24 cable strands of $2\frac{1}{16}$-in. dia for each of the two main cables. The strands were spaced in open pattern, 4 strands wide by 6 strands high.

Since World War II the road has been under control of the Canadian Army Engineers. P. L. Pratley, M. ASCE, consulting engineer of Montreal, has been retained to investigate the failure and to recommend a plan for immediate handling of traffic. Temporarily traffic is handled by a ferry which can make about 50 trips per day, and by a new bridge of the Pacific Great Eastern Railway, 3 miles upstream, which has been decked over for use by highway vehicles. It will be some months before the rails will reach the bridge.

Study of the existing bridge indicates that repair is not feasible and that the bridge must be replaced. Present thinking favors a continuous deck-truss-type structure to avoid horizontal reactions on the uncertain foundation material. Removing the existing bridge will be a major problem. Since no further movement of the slide material has been noted, removal operations are being delayed in the hope that winter will form ice on the river thick enough to serve as a safe working platform. Designers of the new bridge have not been selected.

Peace River Bridge, near southern terminus of Alcan Highway, failed on October 16 due to slip of the hillside and abutment. In pre-crash photo (below) note crushing of truss at the abutment and peculiar distortions of the bent.

Belgium Plans $3 Billion Power Project on Congo

The Belgian government has approved a 25,000,000-kw power project for utilization of the Congo River in the Belgian Congo. Estimated cost of the project, at Inga Rapids between Leopoldville and the Atlantic port of Matadi, is $3,160,000,000. It is expected that the power developed will start the industrialization of central Africa. United States firms are said to be interested in the huge quantities of power available for nuclear, chemical, and light metals development.

The Harza Engineering Company, of Chicago, together with a Belgian firm, was one of five groups retained to study the vast project and make plans for its development. An international group of power specialists, including C. E. Blee, M. ASCE, former chief engineer of the Tennessee Valley Authority, has studied the plans to recommend the scheme to be followed and the engineer group to handle the work.

Transactions of Belgrade Power Conference Available

Power engineers and others interested in the Sectional Meeting of the World Power Conference, held in Belgrade, Yugoslavia, in June 1957, may want to take advantage of a chance to obtain the Transactions of the conference at a price of $150 a set. The set will be in print by the end of the year. Orders should be sent to Stewart E. Reimel, secretary of the U.S. National Committee of the World Power Conference, 29 West 39th Street, New York 18, N. Y. ASCE Past-President Gail A. Hathaway is chairman of the U. S. National Committee.

The theme of the Belgrade meeting was "Energy as a Factor in the Development of Underdeveloped Countries."

Slight Decline in October Construction Activity

Outlays for new construction this October declined seasonally to $4.5 billion, slightly above the previous October high set in 1956, according to preliminary joint estimates of the U.S. Departments of Labor and Commerce.

On a seasonally adjusted basis, new construction activity thus far in 1957 has been at rates indicating that the total for the year will be a little over $47 billion, compared with $46 billion last year. Actual expenditures for the first ten months of this year ($39.4 billion) were 2 percent above the corresponding 1956 figure.

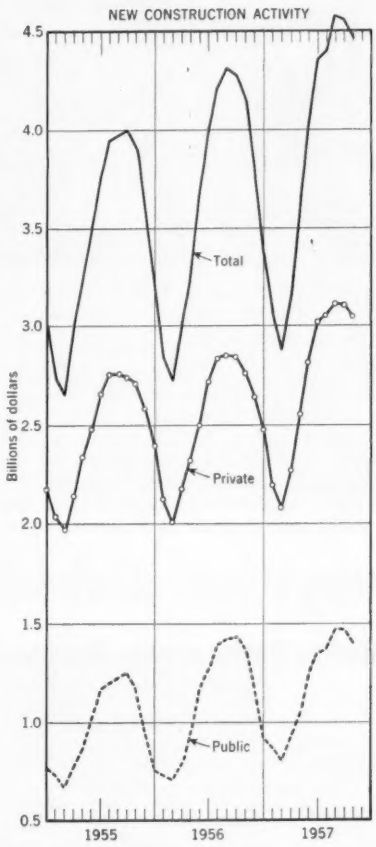
A number of important construction categories continued to show unusual strength in October. Private outlays for public utilities construction reached a new monthly peak, exceeding the half-billion-dollar mark for the fifth consecutive time. Expenditures for offices and warehouses also were at an all-time high last month, while outlays for highways, residential additions and alterations, public schools, conservation and development work (mainly dams and irrigation projects), churches, sewer facilities, and private hospitals were greater than in any previous October. Highway construction, especially, has surged sharply upward in recent months, with a rise of 11 percent from August to October, after seasonal adjustment.

The value of work put in place on new private dwelling units, after allowance for seasonal changes, continued the gradual advance that began last June. Thus the gap between present and year-ago levels has been reduced from 14 percent in April to 6 percent in October. Store-building activity, likewise, has gained strength in recent months: the volume this October was off only 3 percent from a year earlier, while the spread between February 1957 and February 1956 was 19 percent.

On the other hand, private industrial building and public water supply facilities, both of which showed a vigorous upward movement throughout most of the past two years, have tapered off somewhat since mid-summer. However, expenditures for private plant expansion from January through October 1957 were still 5 percent above the comparable 1956 total, and outlays for construction of new water systems during those months were about the same in both years.

Total private construction activity so far this year ($27.6 billion) just about equalled last year's record for the first ten months. Declines from 1956 in expenditures for new dwelling units and stores were largely offset by advances in all other types of private construction, except school building.

Public construction outlays, which totaled $11.8 billion during the January-October 1957 period, were 8 percent above the corresponding 1956 figure, with all construction categories, except military facilities, contributing to the increase. The most significant dollar gains were for construction of public schools and highways, virtually all of which are state and locally owned, and for public residential building, mainly because of a step-up in the Capehart military housing program.



Despite seasonal decline in construction this October (to 4.5 billion), total for month is still slightly above the previous October high set in October 1956.

International Airport Structures Ready Soon

The new $30,000,000 International Arrival Building and adjacent Airline Wing Buildings in Terminal City at New York International Airport is now completed. It will be dedicated on December 5 and put into regular operation after midnight that night. The spectacular structure, which is eleven city blocks long, will handle all arriving overseas passengers requiring federal inspection and all passengers departing on foreign-flag airlines. The cost of the facilities within the 655-acre Terminal City is estimated at $150,000,000.

Construction of the New York International Airport was started by the City of New York in 1942. The city, at a cost of $60,000,000, filled the site, installed utilities, and built six runways, two hangars, and a small administration building before leasing the airport to the Port of New York Authority in 1947. The Port Authority has since spent about $150,000,000 on improvements, bringing the total public investment to date to about $210,000,000.

There are ten hangars at the airport, and three others are under construction. Other installations include an eleven-story control tower, a federal building, four industrial buildings, an Operations-Cargo Building, and an air cargo center. Construction of an airport hotel is under way. With an area of 4,900 acres, the new airport is nine times the size of La Guardia Airport.

Havana Bay Tunnel Nears Completion

A Cuban dream of seeing Havana linked by vehicular tunnel with East Havana across the bay is nearing reality after half a century of disputes and delays. Scheduled for completion early in 1958, the four-lane trench-type tunnel is the largest and most costly ($28.5 million) engineering project ever undertaken in Havana. It consists of five 360-ft-long prefabricated sections of prestressed concrete, constructed in a dry-dock dug out of the eastern bank of the channel and sunk in a trench for link-up under water. Maximum depth of the channel is 70 ft below sea level. Construction of the project began in 1954, but preliminary studies of the tunnel site and solutions to the problems involved had been completed years before.

With the eastern shore accessible to Havana proper only by boat or by a 20-mile traffic-jammed drive around the back of the bay, East Havana has remained isolated and virtually barren of building development. Now that only minutes will separate the old city from its eastern shore, a large land development and building program is taking shape.

A French construction firm, the Société des Grandes Travaux de Marseilles, was engaged to build the tunnel. The supervising engineer is Jose Menendez, M. ASCE, engineer on the only other vehicular tunnel in Havana, a four-lane auto tube under the Almendares River.

All-welded Girder Bridge for Redwood Highway

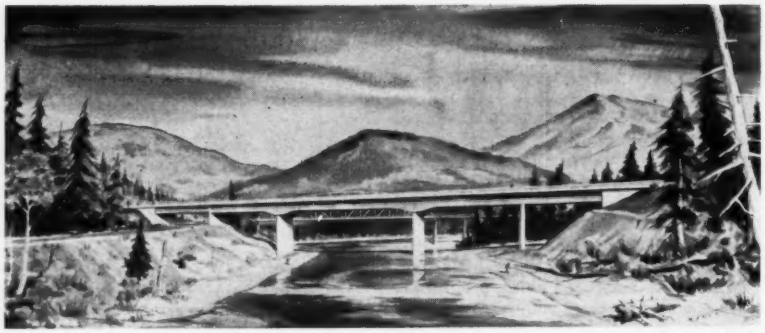
Now under construction as a part of the realignment of U.S. Highway 101 through the scenic California redwood country is an all-welded girder bridge of record proportions for the West. The bridge, which has a main span of 275 ft and side spans of 170 ft in the central three-span continuous unit, will carry the four-lane Redwood Highway over the South Fork of the Eel River at Dyerville. The roadway width is 56 ft between curbs.

The bridge cross section consists of a concrete deck slab supported directly on the top flanges of four welded girders. The depth at the haunches is 15 ft, and mid-span depth is 10 ft. A-242 steel with a minimum allowable stress of 22,000 psi is used in the flanges. Maximum flange size is 28 by 2⅛ in.

The piers are about 60 ft high and of cellular design with outside dimensions of 5 by 83 ft. The constant cross-section permitted the contractor to achieve economy by the use of the slip-forming method. Total cost of the structure is $1,459,000, or $27.40 per square foot.

When completed the bridge will be officially dedicated as the "George Leatherwood Memorial Bridge" in memory of a highway engineer who was prominent in the planning of the new Redwood Highway. It was designed by the Bridge Department of the California Division of Highways under the general supervision of F. W. Panhorst, M. ASCE, Assistant State Highway Engineer, Bridges.

(John J. Kozak, A.M. ASCE, senior bridge engineer, supplied material for this item.)



Eel River Bridge on Redwood Highway is said to break Western records for all-welded girder bridge. Old through-truss span, which will remain in place, is visible in the background.

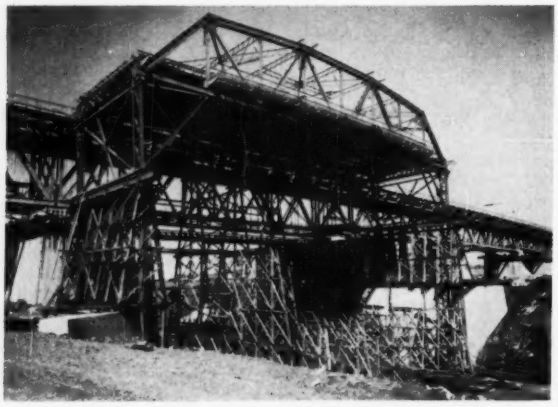
Long Truss Rolled to Position over Seaway Channel

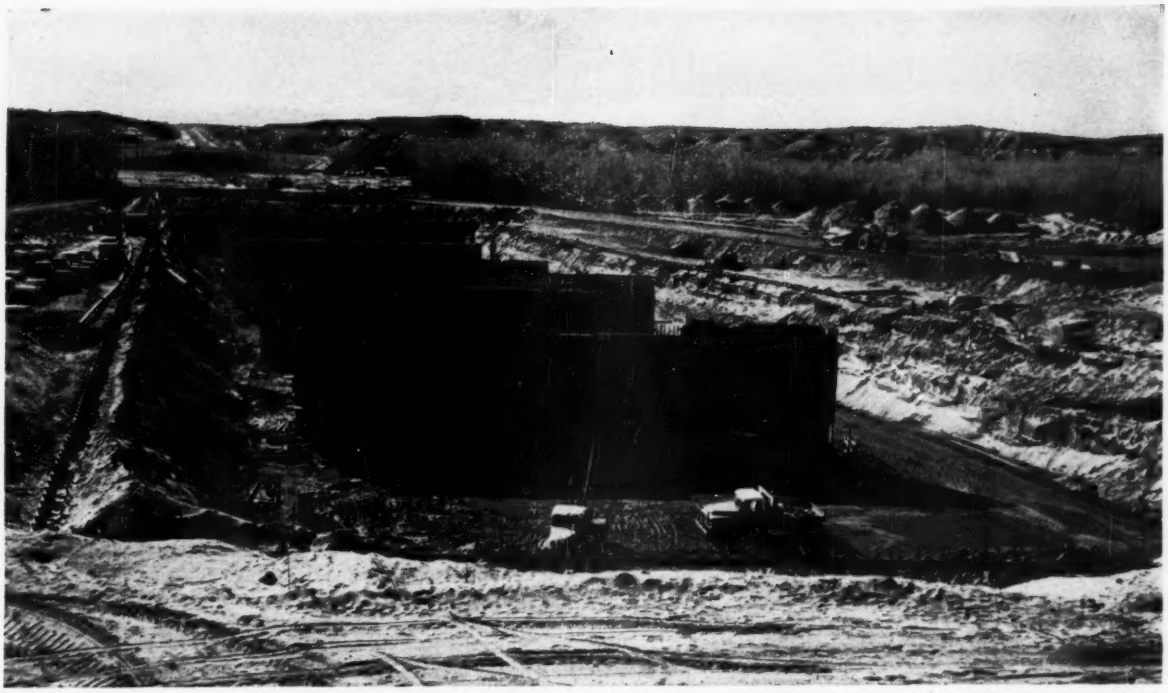
Raising Jacques Cartier Bridge 80 ft to provide 120-ft clearance over the St. Lawrence Seaway Channel is being done in two related steps of a single $7,000,000 project. The structure, built in 1929 by the Dominion Bridge Co., is being raised by Dominion under a contract with the St. Lawrence Seaway Authority. The raising operation, which will continue for more than a year, involves the jacking of adjacent spans a few inches at a time to raise the span to a 4.2 percent grade. This will lift the span at the crossing of the new seaway channel 50 ft, all without stopping traffic.

By changing from a deck truss to a through truss at the 248-ft channel span, an additional 30 ft of clearance was quickly gained. A 60-ft-wide through truss was assembled on timber falsework. The old and new trusses were mounted on 42 rollers, 6-in. in diameter, riding on seven rails. At each end of the span, a 300-ton jack, with 4-ft travel, was rigged to pull the old and new trusses 78 ft sideways. As each 4-ft move was made the structure was carefully watched to assure that neither end gained more than 2 in. A steel link was dropped out after each incremental move. Swapping the spans was accomplished early Sunday morning, October 20, with only five hours delay to traffic.

Design for both the original bridge and the plans for raising it were made by P. L. Pratley, M. ASCE, of Montreal.

Downstream runway of Jacques Cartier Bridge at Montreal showing one of two 300-ton hydraulic jacks (left) and link chains used to pull spans into new position during process of raising the structure 80 ft. General view from upstream side (at right) shows new 248-ft through truss span mounted on trestle runways and ready for change-over. Photos courtesy St. Lawrence Seaway Authority and Dominion Bridge Company, Ltd.





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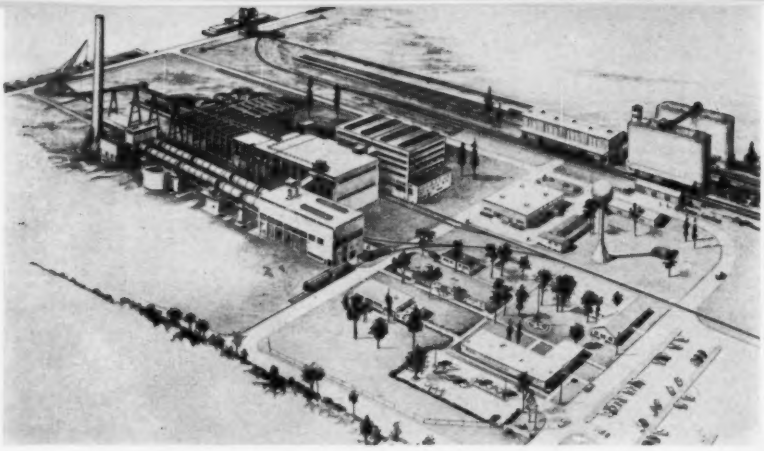


Lone Star Cement Opens Large Louisiana Plant

One of the world's most modern portland cement plants was officially opened at Lake Charles, La., on October 23. The new multi-million-dollar structure, built by the Lone Star Cement Corp., is shown here in artist's sketch. Located five miles south of Lake Charles on the Calcasieu River, adjacent to the Intracoastal Waterway, the plant produces 28,000 sacks a day, or 2,000,000 barrels a year, for the construction and oil industries in the Gulf Coast area. Use of precast and prestressed concrete was featured for all the new buildings, which house some of the world's largest moving machinery. Construction time was twenty months. General contractors for the new plant were Frank Miller & Sons, of Lake Charles, and the Walsh Construction Company, of New York City. Most of the engineering was handled by F. Shutts' Sons, of Lake Charles.

R. ROBINSON ROWE, M. ASCE

"You forgot to tell how heavy was the clown," complained Joe Kerr, "and besides I had to do my Xmas shopping and send out cards."

"Jabberwocky!" muttered Cal Klater.

"Not at all," judged Professor Neare. "Joe just has two alibis for not doing the clown-and-ladder problem. One's pretty good."

"Xmas may be good, but he didn't need the clown's weight," said Cal.

"Well, the friction factor, then," persisted Joe.

"Neither," insisted Cal. "Nor the ladder weight either. Let the ladder weigh W and the clown kW. Then if the vertical reaction at the toe of the ladder at the point of slipping is rW and the friction factor is f, the horizontal force resisting slipping is frW. To balance horizontal forces, the pressure of the ladder against the wall is also frW, and since this end of the ladder is at the point of slipping down, there must be a vertical resisting force of f^2rW here (Fig. 1)."

"Oh!" whispered Joe.

"Then if we equate downward to upward forces and solve for r:

$$rW + f^2rW = W + kW \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$r = (1 + k)/(1 + f^2) \quad . \quad . \quad . \quad (2)$$

we find r to be constant in terms of constants k and f. Then if the ladder is set b ft from the wall, making an angle ϕ with the horizontal, and if the clown stands on the nth rung as it starts to slip, moments about the toe give:

$$0.4nbkW - frWb\tan\phi = bf^2rW - .5bW \quad (3)$$

$$.04kn - fr\tan\phi = f^2r - .5 \quad . \quad . \quad . \quad . \quad . \quad (4)$$

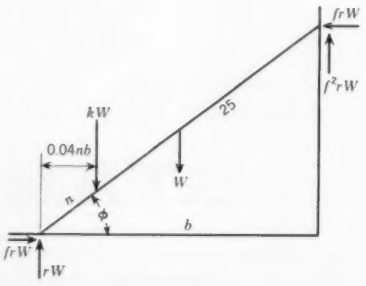


Fig. 1. Willie, the clown, learned this about ladders the hard way.

Then, since r, k and f are constants, let $A = .04k$, $B = fr$, and $C = f^2r - .5$, and

$$An - B\tan\phi = C \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

"From this linear relation we can determine the coefficients A, B and C without finding the weight of the clown or the friction. We are given for $n = 5$ that $b = 20$ or $\tan\phi = 3/4$; also for $n = 9$ that $b = 15$ or $\tan\phi = 4/3$. Substituting in (4) defines this relation as

$$7n - 48\ \tan\phi = -1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

so that when Willie set the ladder finally with $\tan\phi = 2.5$, the critical rung was $n = 17$."

"Easy," said Joe, "if I'd only had time."

"Took five minutes," bantered Cal.

"And I can add that it wasn't even necessary to use the same friction factor for the wall as for the pavement," concluded the Professor, "but if equal, $f = .254$ and $kW = 166$ lb, the weight of Willie.

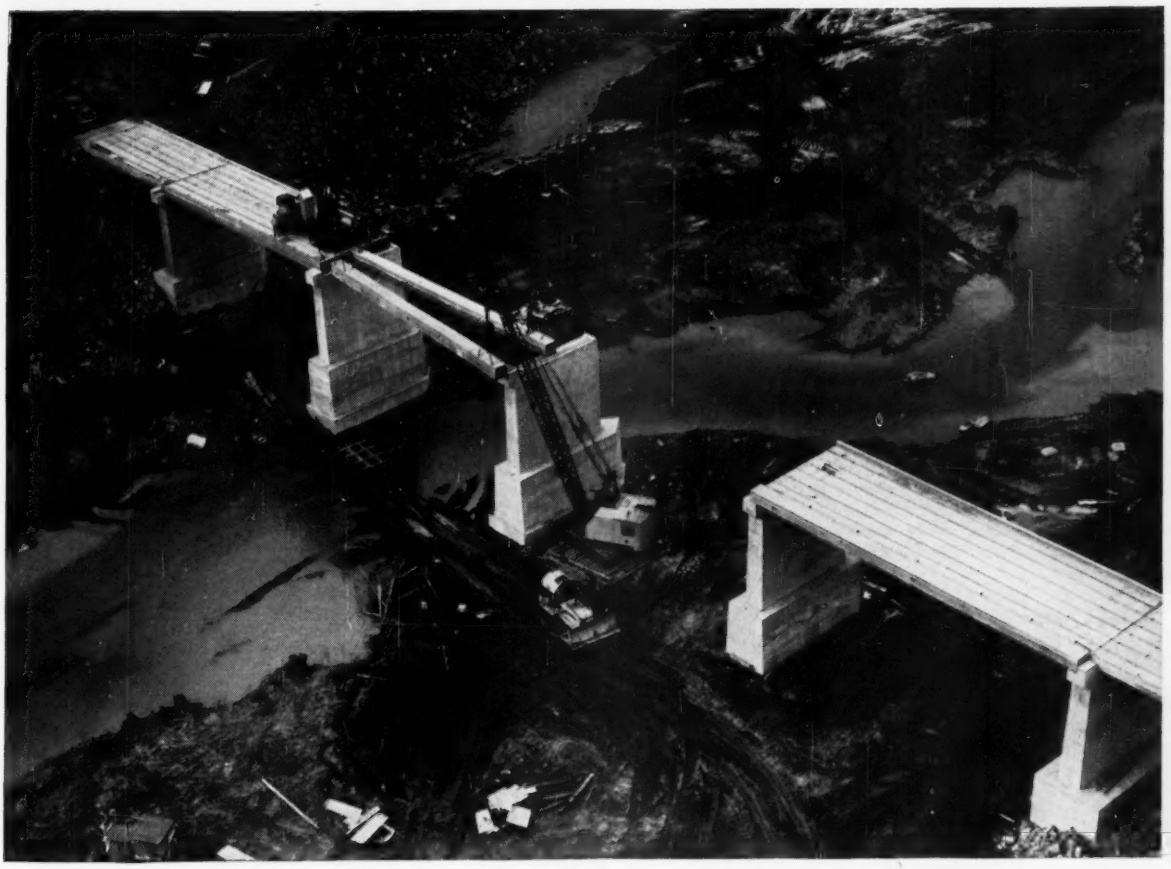
"The scene of our next problem is Uterivoria, an island of 1,000 woxes and 1,200 folves, and nothing else. Neither animal being cannibal, each kind preys on the other, at the rate of .05 folf per wox and .04 wox per folf per year. Birth rates being 7 percent for woxes and 6 percent for folves, which will starve to death, and when?"

[Cal Klaters were: Richard Jenney, Del Awarian (George Hyland), Murray S. Bornstein, James M. Gere, Paul H. Sanders, David V. Messman, Ernest M. Myer, and Thatchrite (Guy C. Thatcher).]

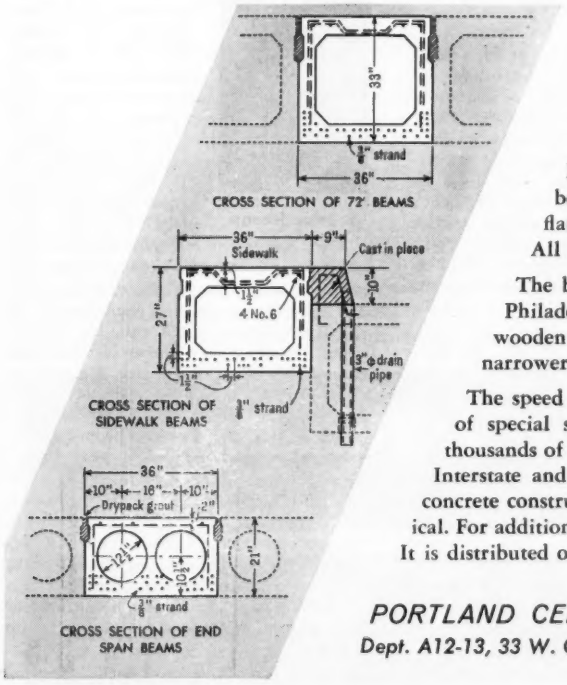
AEC Dedicates New Headquarters Building

President Eisenhower headed a group of notables on hand for the dedication of a new headquarters building for the Atomic Energy Commission on November 8. Located on a 110-acre site near Germantown, Md., the new structure will provide office space for the Commission's 1,600 Washington employees. The four-story building is of monolithic reinforced concrete faced with red brick. Auxiliary buildings include an auditorium, cafeteria, and warehouse. Parking space has been provided for a thousand cars.

A contract for construction of the entire project, with the exception of one wing, was let in May 1956 to John McShain, Inc., of Philadelphia. Following authorization by the 85th Congress, a contract for building the additional wing was awarded to the John A. Volpe Construction Company, of Malden, Mass., in August 1957. The extra wing will be completed in September 1958. The architect for the project is the New York firm of Voorhees, Walker, Smith & Smith.



379-ft. bridge deck erected in eight days using Precast, Prestressed CONCRETE



By using precast, prestressed concrete beams it was possible to erect the deck of the 379-ft. Knight Road Bridge near Philadelphia in only eight days.

The beams were made on the prestressing beds of a casting yard ten miles away and trucked to the site. Each of the bridge's end spans is 45 ft. 3 in. long. Each of four interior spans is 72 ft. 2 in. long. Seven beams in each span form a 20-ft. roadway. An eighth flanking beam on one side serves as a 3-ft. sidewalk. All beams are pretensioned hollow girder design.

The bridge, spanning a newly-created reservoir of the Philadelphia Suburban Water Company, replaces an old wooden covered bridge. It was raised 24 ft. by adding narrower sections atop the old piers.

The speed with which this bridge deck was erected is of special significance to engineers in planning the thousands of bridges needed on the National System of Interstate and Defense Highways. Precast, prestressed concrete construction is not only fast but also economical. For additional information send for free literature. It is distributed only in the United States and Canada.

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A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

DECEASED

Warren W. Chapin (M. '23), age 82, consulting structural engineer and head of the New York City firm bearing his name, died on June 6. Mr. Chapin had been in private practice, specializing in building design. He was a graduate of Stevens Institute of Technology.

Thomas P. Clonts (M. '21), age 74, consulting engineer of Muskogee, Okla., died recently. Mr. Clonts had been in private practice for much of his career, as a partner in the firms of Clonts and Tail, Burnham and Clonts, and as president of the Clonts-Morgan Engineering Company. He had been city engineer of Muskogee. Mr. Clonts was a graduate of the Agricultural and Mechanical College of Texas.

Herbert A. Davies (A.M. '18), age 68, former vice-president of the American Bridge Division of U. S. Steel Corp., died on September 13. His home was in Roanoke, Va., where he was a member of the City Council. Mr. Davies had served the steel industry for 50 years, and was one of the most widely known steel executives in the South. During his career with the Virginia Bridge & Iron Company (predecessor of American Bridge) Mr. Davies worked in the engineering, contracting and operating departments, and served as manager of the Memphis and Birmingham plants. He was graduated from Virginia Polytechnic Institute.

Charles William Doerr (M. '44), age 67, vice-president of erecting operations for the American Bridge Company, Pittsburgh, died on October 5. Mr. Doerr had been with the company since 1912, serving as structural draftsman, field engineer on erection of steel structures, and engineering assistant in the office of the division erecting manager. Mr. Doerr graduated from the University of Michigan.

Frank Doughty (A.M. '16), age 79, retired civil engineer, died recently at his home in San Jose, Calif. Prior to his retirement, Mr. Doughty was a member of the firm of Haas, Doughty & Jones, engineers of San Francisco. He had been in private practice for some years. Early in his career, Mr. Doughty was district engineer for the U. S. Reclamation Service on several projects.

Ernest E. East (A.M. '25), age 77, retired chief engineer of the Automobile Club of Southern California, died in Huntington, Calif., on November 7. Mr. East was credited with being the "father of the Los Angeles freeway system," which he began to outline more than twenty years ago. On the staff of the auto club since 1920, Mr. East led exploration trips to Mexico and San Salvador, proving that construction of a West Coast Pan-American highway was possible. Mr. East was graduated from Purdue University.

Ray O. Edwards (M. '48), age 65, for many years executive director of the State Housing Authority at Jacksonville, Fla., died on September 21. Mr. Edwards had been state, regional, and national president of the National Association of Housing Officials, and director of the National Housing Conference. He was active in civic affairs and in the Sons of the Revolution, in which he had held top posts. He was a graduate of Purdue University.

Linn Enslow (A.M. '25), age 66, editor of *Water and Sewage Works* magazine since 1931, and authority in the field of water supply and sewage disposal, died on November 3, at his farm in Dublin, Va. Before joining the editorial staff of *Water and Sewage Works*, Mr. Enslow had been research and development engineer of the Chlorine Institute. He was widely known for his articles on chlorination, as well as for the development of a chlorine comparator and the "Enslow Stability Indicator." Mr. Enslow was active in many professional groups, including the New York Sewage and Industrial Wastes Association, and the Federation of Sewage and Industrial Wastes Associations, which he had served as vice-president, director, and chairman of publicity. He had also been chairman of ASCE's Sanitary Engineering Division. Mr. Enslow was educated at Virginia Polytechnic Institute and Johns Hopkins University.

Linn Enslow

Leo J. Foster (M. '41), age 74, retired design and construction consulting engineer in the U. S. Bureau of Reclamation at Denver, died recently. Mr. Foster began his work in the Bureau as field assistant, and was promoted to successively more responsible jobs until he assumed a post on the chief engineer's staff. He established the longest service record (48½ years) ever achieved by a Reclamation Bureau employee. Mr. Foster held B.S. and M.E. degrees from the Missouri School of Mines.

Bennett T. Gordon (M. '47), age 55, a resident partner in the Philadelphia office of Richardson, Gordon and Associates, consulting engineers, died there on October 17. His home was in Haverford. Mr. Gordon was the designer of a number of new bridges in the Philadelphia area. He had also worked on the planning and design of the Golden Gate, Chesapeake Bay, and Potomac River bridges. He had served in several public engineering posts in Allegheny county and Pittsburgh.

Wells Woodward Grotta (M. '48), age 55, senior highway engineer for the Connecticut State Highway Department, Hartford, Conn., died recently. Mr. Grotta had served the department for many years as highway maintenance engineer and division engineer of administration.

Winters Haydock (M. '19), age 77, former regional director of the United States Housing Authority and regional co-ordinator of the Defense Housing Administration, died at his home in Alexandria, Va., on October 21. Prominent in railroad engineering early in his career, Mr. Haydock served various Midwest lines in a construction capacity. Mr. Haydock had been chief engineer for the Municipal Planning Association of Pittsburgh. In 1950 he entered private practice, and in 1952 became vice-president and director of City Suburban Homes Corp., a Washington home-building firm. Mr. Haydock was the author of two books, "Long Term Financial Program for Rental Housing" and "Who Owns the Slums?" He was a graduate of Washington University.

Carl Edward Jacobson (M. '57), age 59, bridge designer with the Georgia State Highway Department, died at his home in College Park, Ga., on October 5. Mr. Jacobson began his career with the Pennsylvania State Highway Commission. Subsequently he worked as project engineer for the Missouri Highway Commission, and as bridge, building, and design engineer for the Atlanta & West Point Railroad, the Western Railway of Alabama, and the Georgia Railroad.

Joseph John Jessup (M. '12), age 91, former city engineer of Los Angeles and a pioneer engineering educator in California, died in Los Angeles on October 27. After earning his bachelor's and master's degrees at Penn College, in Iowa, Mr. Jessup served as professor of mathematics and science at Pacific College, in Oregon, and as president of Whittier Academy (now Whittier College). It was Mr. Jessup who laid the ground work necessary to achieve collegiate standing for Whittier. After leaving Whittier, he studied and taught at the University of California for several years. Deciding on a career in municipal service, Mr. Jessup was city engineer of Berkeley from 1906 to 1918 and civil engineer for several California municipalities from 1918 to 1930. From 1930 to 1934 he served Los Angeles as city engineer. During the first World War, when the YMCA desperately needed engineers, he volunteered for a year's service in France supervising construction and salvage of their buildings. From that date until his death Mr. Jessup practiced as a consulting civil and mining engineer, and was widely known as an authority on mining developments.

J. John Jessup

(Continued on page 108)

Another LEFFEL TURBINE FOR KENNEWICK

Now, there are Leffel hydraulic turbines at work in two Kennewick Division stations . . . the recently completed Amon Pumping Plant and the Chandler Power and Pumping Plant. Located in the southeastern section of the State of Washington, the Kennewick Division of the Yakima Project is being developed by the Bureau of Reclamation of the U.S. Department of the Interior.

The Amon Pumping Plant, unusual because of its outdoor installation, is powered by a Leffel turbine which withstands the effects of wind and sand, in addition to performing at top turbine efficiency. This turbine is the horizontal shaft discharge spiral case type, and is rated to develop 700 H.P. under 63 ft. net head, speed 600 R.P.M. Directly connected at each end to a centrifugal pump, the turbine unit has a discharge elbow coming off either side. This turbine, like larger Leffel turbines throughout the world, harnesses water power efficiently and economically.

Leffel has the technical knowledge and wide range of experience necessary to design and build hydraulic turbines for most any size installation.

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World's longest suspension bridge

Built for STATE OF MICHIGAN
MACKINAC BRIDGE AUTHORITY

Consulting Engineer: Dr. D. B. Steinman
Associate Consultant: Glenn B. Woodruff
Substructure Contractor: Merritt-Chapman & Scott Corporation

open for traffic!

Facts and figures:

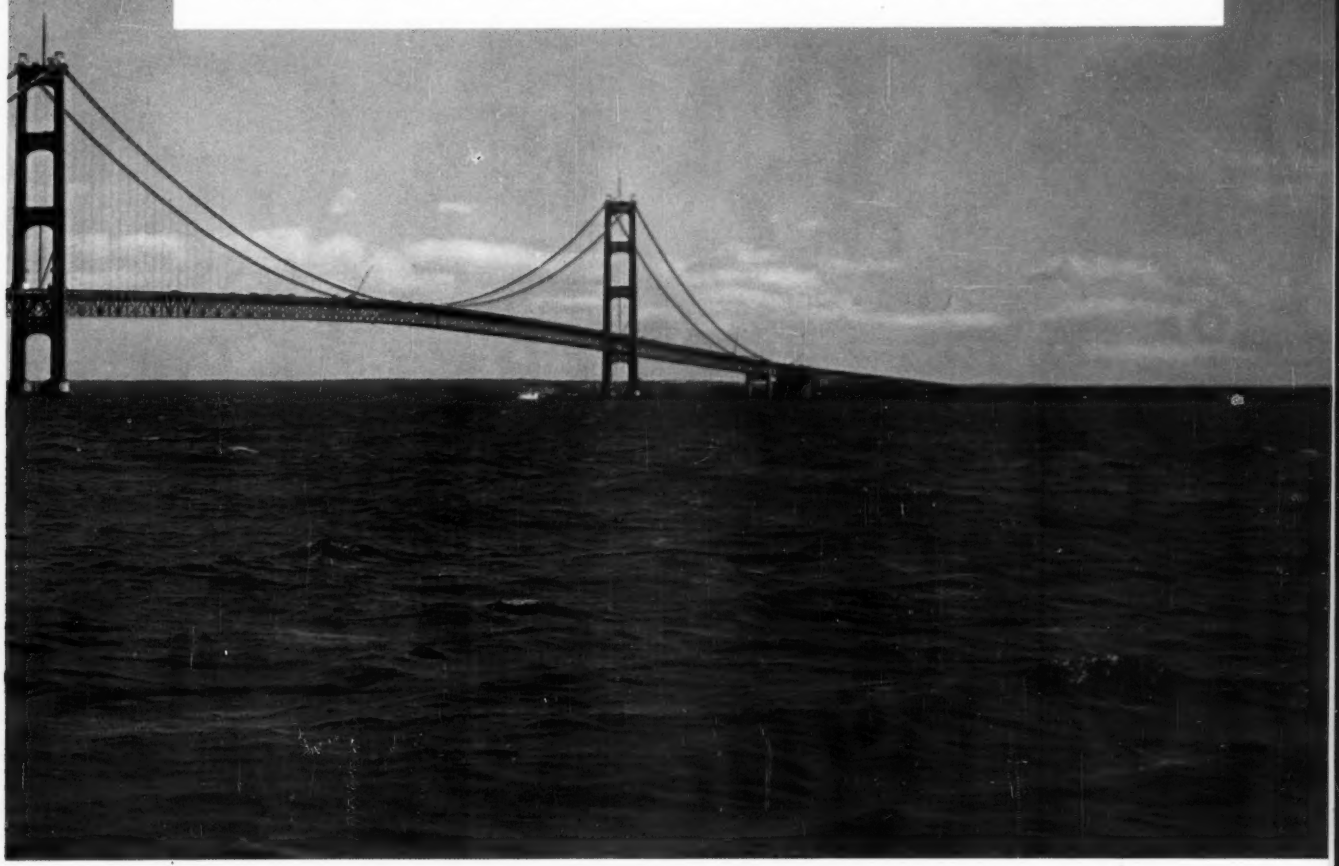
Location: Straits of Mackinac—between Mackinaw City and St. Ignace, Michigan

Erection of Steel Superstructure Began on July 2, 1955 Opened to Traffic, November 1, 1957

Total Length of Steel Superstructure	19,205 ft.
Total Length of Suspension Bridge	8,614 ft.
Length of Main Span	3,800 ft.
Length of North Approach (Steel)	4,310 ft.
Length of South Approach (Steel)	6,281 ft.
Total Length of Bridge and All Approaches	26,444 ft.
Height of Main Towers Above Water	552 ft.
Depth of Tower Piers Below Water	206 ft.

The bridge provides a minimum clear height at center of main span of 148 ft.—sufficient to allow passage of the largest Great Lakes ships.

Width of Roadway	48 ft.
Number of Main Cables—2 Diameter of Main Cables	24½ inches
Total Estimated Weight of Superstructure	67,300 tons
Cost	$96,400,033.33



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UNITED STATES STEEL

Record-breaking use of USS AmBridge

. . . trims 8,720 tons of dead weight . . . speeds bridge

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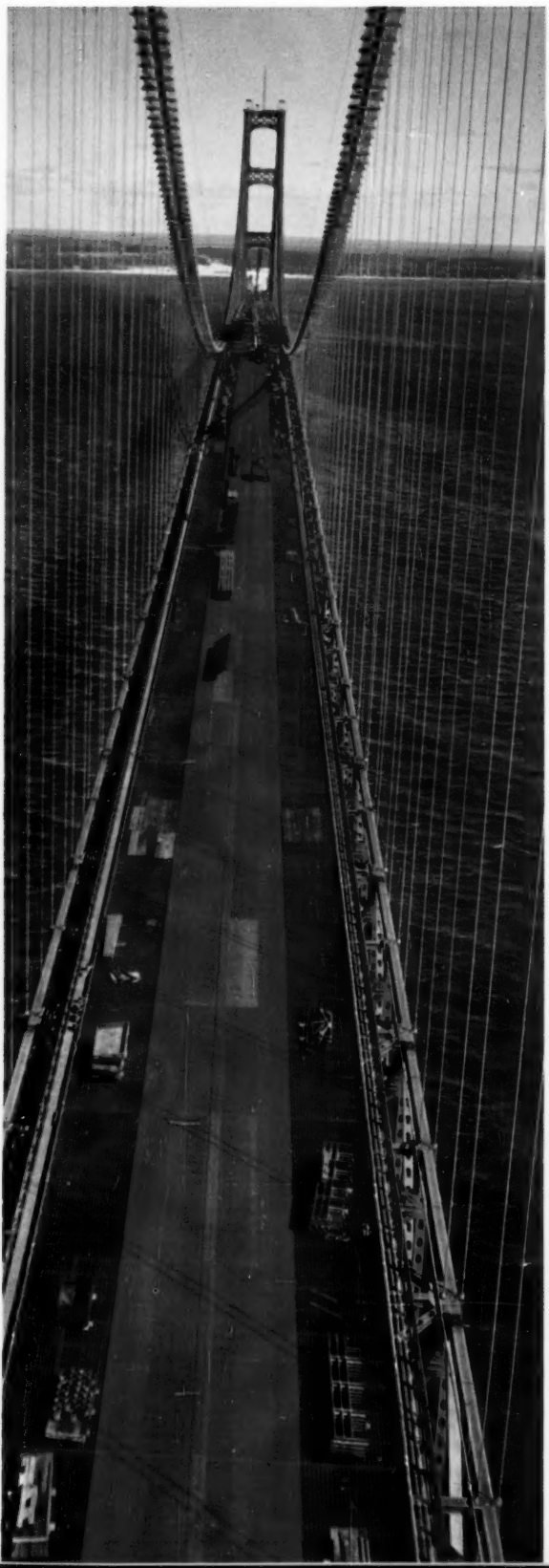
USS

I-BEAM-LOK flooring

completion . . . provides weather-free traffic lanes



IN character with the rest of the job, the flooring of the world's longest suspension bridge also exemplifies bold engineering and effective use of materials.

By covering the entire suspended roadway with lightweight I-Beam-Lok:

. . . floor weight was more than cut in half
. . . the bridge was open to traffic months earlier
. . . weather-free traffic lanes and improved aerodynamic stability were secured

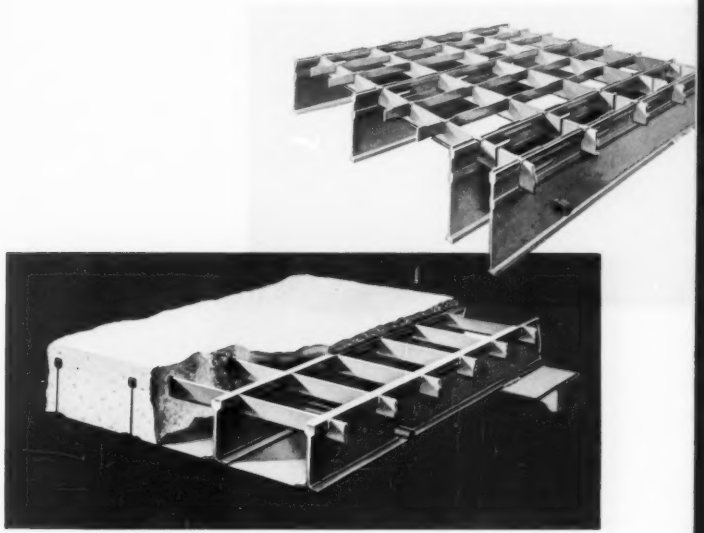
Here are the details:

The suspended roadway is comprised of two inner lanes 7,400′ x 11′, two outer lanes 7,400′ x 12′, and a 7,400′ x 2′ median strip—362,600 sq. ft. in all. Using 5″ PL-Type, Open I-Beam-Lok on the inner lanes and median strip, and 4¼″ filled I-Beam-Lok on the outer lanes, total floor weight was 7,597 tons as compared with 16,317 tons had conventional flooring been used.

Weight saving is only part of the story. Time was also a vital factor, and there is no doubt that the speed with which I-Beam-Lok could be installed, and the ideal working platform it provided, permitted the bridge to be opened and start paying for itself months earlier.

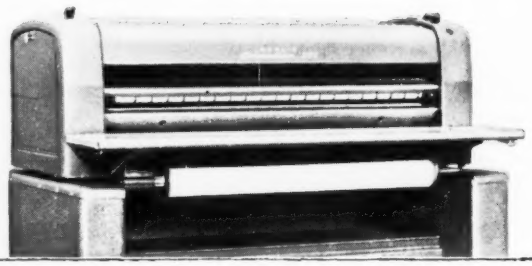
And finally, the open I-Beam-Lok invites both snow and wind to go right on through, assuring good driving conditions during howling Mackinac winters when snow would pile up on a solid floor, and preventing the build-up of dangerous wind pressure.

While this job represents the biggest use of I-Beam-Lok ever, the product's many advantages apply to bridges of all sizes—for new installations or reflooring. For catalog, write to our headquarters in Pittsburgh.



USS AmBridge I-BEAM-LOK
lightweight steel flooring

How to make design changes in minutes . . . and cut drafting costs, too



There's no more need to bog down drafting operations with time-wasting tracing or redrawing of your original design.

Now with Ozalid intermediate materials, you can make design changes quickly, neatly, easily. Ozalid intermediates give you exact duplicate originals that can save you *hours* of drafting time. Specific detail changes are as simple as 1–2–3. Just make an Ozalid intermediate print . . . on film, translucent paper, or cloth . . . and remove obsolete details with Ozalid Corrector Fluid. If you prefer, unwanted details can be removed by "scissor-editing" or the "lock-out" method. Next, draw in your new design and you've got a new, up-to-date original . . . all ready for running prints.

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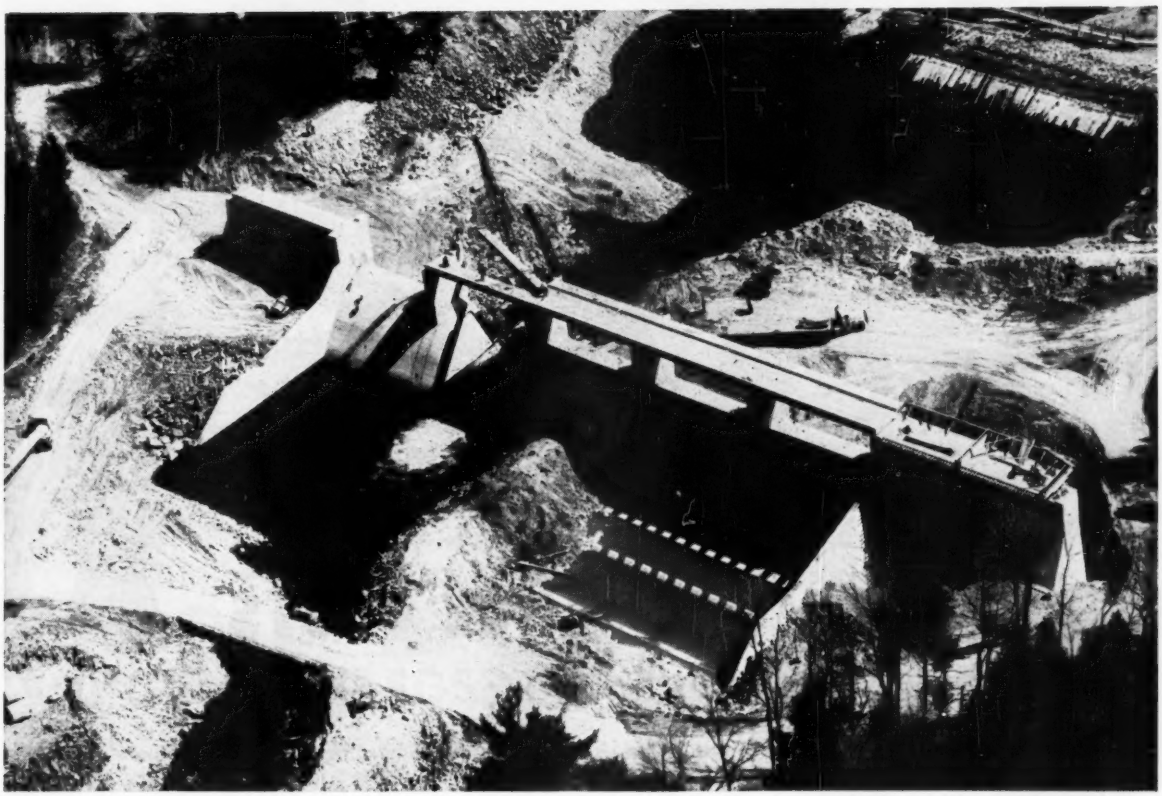

Shown here are 44 ft. long AMDEK box-section prestressed concrete members being installed at Pocono Lake Preserve Dam, Pa. This is one of hundreds of installations of AMDEK members, originated and fabricated by American-Marietta Company, whose Concrete Product Division plants are strategically placed throughout the nation.

Consulting Engineers: Justin & Courtney

Contractor: Reed & Kuhn, Inc.

Every day brings further proof of the wide acceptance of prestressed concrete as a **Versatile Structural Material*. Engineers and architects throughout the country, quick to recognize the economies and advantages it offers, are constantly finding new uses for it. As a result, precast, pretensioned members in standard cross sections are available in most localities today!

In buildings, the chief uses are long-span deck members and supporting girders. Deck members of double tee, channel sections or joists, span up to 40 ft. for floors and to 60 ft. for roofs.

Girders and bridge beams occasionally run up to 100 ft., or as long as can be transported. Bridge members are I section stringers with poured-in-place concrete slab, or box sections laid side by side.

It will pay to investigate the opportunities prestressed concrete offers. For data on tensioning materials and general information on prestressed concrete, write Construction Materials Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

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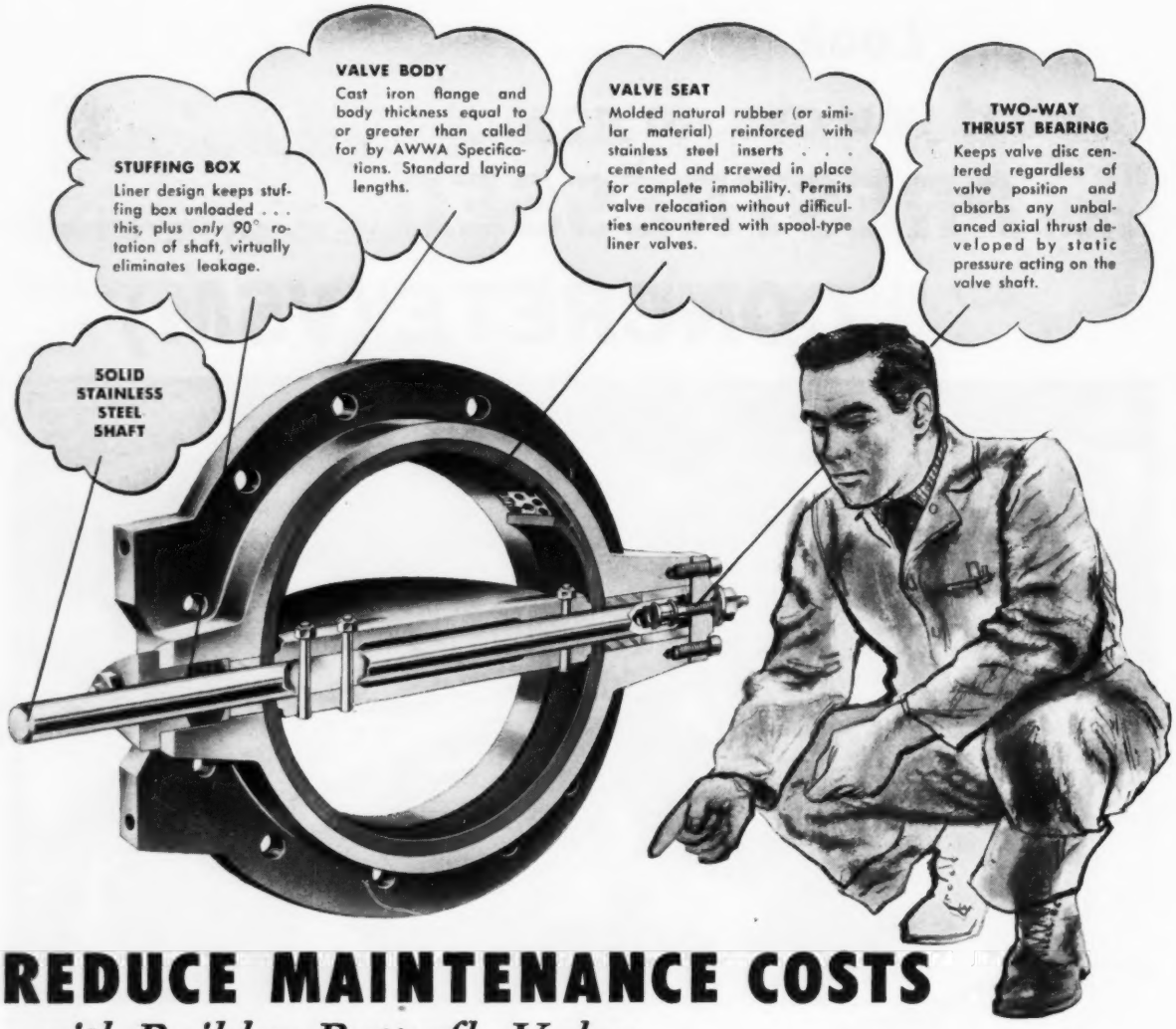
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Molded natural rubber (or similar material) reinforced with stainless steel inserts . . . cemented and screwed in place for complete immobility. Permits valve relocation without difficulties encountered with spool-type liner valves.
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Keeps valve disc centered regardless of valve position and absorbs any unbalanced axial thrust developed by static pressure acting on the valve shaft.
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Liner design keeps stuffing box unloaded . . . this, plus only 90° rotation of shaft, virtually eliminates leakage.
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Strict adherence to sound engineering and advanced hydraulic principles accounts for the high durability of Builders Butterfly Valves. These design features, plus extra-sturdy construction result in valves which last the life of the plant and require minimum maintenance.

Remember, too, that these Butterfly Valves are backed by Builders specialized knowledge of water and sewage works metering and control problems. Builders Butterfly Valves are built to AWWA specifications . . . for water and sewage works service.

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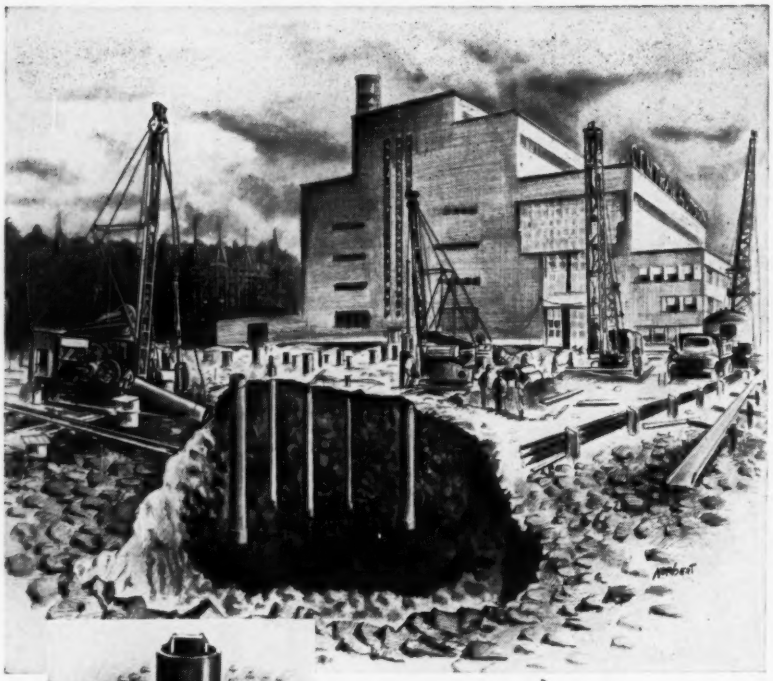
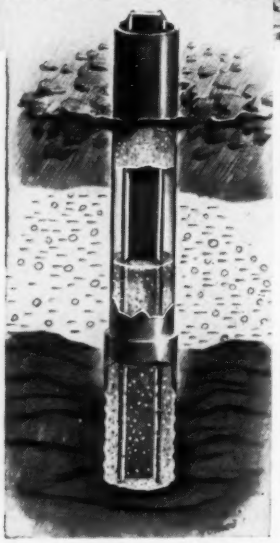
for foundation which must bear heavy loads





Cross section shows caisson shell, concrete filling and steel core. 92 such caissons of 24 and 30-inch diameter were drilled and driven through rip-rap and obstructions, and socketed into rock, for this power plant foundation.

Project: 3rd Unit of Steam Station at Danskammer Point, Roseton, N. Y. for Central Hudson Gas & Electric Corp.

Burns & Roe, Inc., Engineers and Constructors, New York City.

In handling this 3rd foundation unit of the power plant, Spencer, White & Prentis used the same special caisson process as was used for the 2 earlier units. The process offers many advantages. Regardless of ground conditions, water and obstructions, steel caissons can be installed to great depths to bedrock. The core is then embedded in a socket drilled in this sound rock (see sketch at left). Such "locked-in-the-rock" foundations will support superstructure loads up to 1,700 tons each. If necessary, caissons can be placed close to adjoining buildings, thus eliminating cantilevers.

LITERATURE ON REQUEST

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Deceased

(Continued from page 98)

Barton Mills Jones (M. '31), age 72, retired chief engineer and general manager of the Miami Conservancy District, Dayton, Ohio, died on October 14. Among the outstanding hydraulic and hydroelectric projects Mr. Jones worked on were the construction of the Miami Conservancy District, and the Tennessee Valley Authority. During the latter connection, he was in direct charge of construction of Norris Dam and was chief design engineer for the TVA. Later he was engineering director of the Central Hidro-Electrica del Canon del Pato in Peru. At one time Mr. Jones was head of the engineering department of Antioch College. Mr. Jones was a graduate of the University of California.

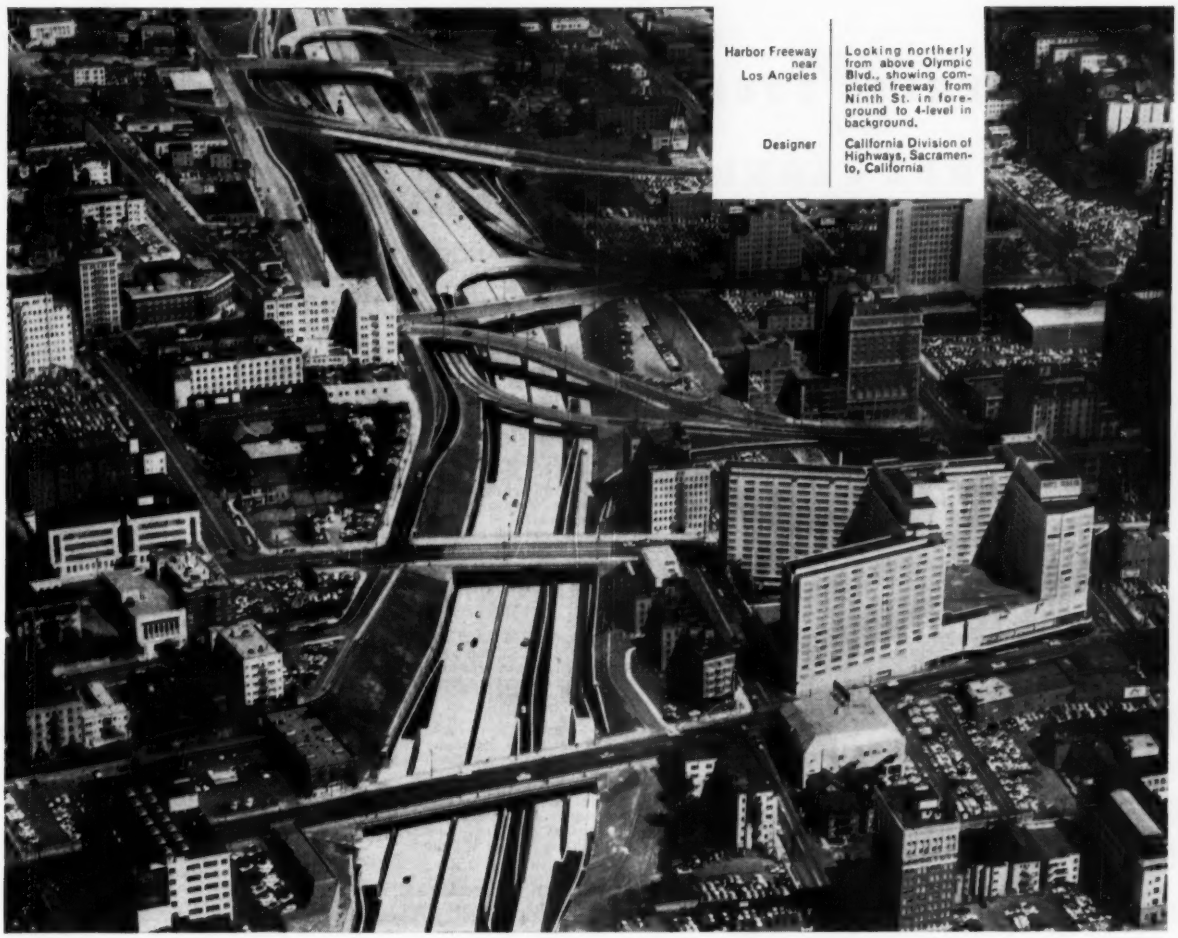
Robert T. Knapp (M. '35), age 58, professor of hydraulic engineering at the California Institute of Technology, died in Pasadena on November 7. Dr. Knapp had been a member of the Caltech faculty for 35 years, and was widely known for his work in hydrodynamics. He had long been active in the American Society of Mechanical Engineers, and had received several of its honors. During World War II he served as official investigator for the office of Scientific Research and Development, and was later a consultant to the U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground. Dr. Knapp received his B.S. at the Massachusetts Institute of Technology and his Ph.D. at Caltech.

William Sutton McFetridge (M. '07), age 83, consulting engineer for the Bessemer & Lake Erie Railroad at Greenville, Pa., died recently. Mr. McFetridge had been with the Bessemer & Lake Erie and its predecessor lines for most of his long career which began in 1895. He specialized in valuation work, and for a number of years was principal assistant engineer. He was a graduate of Lafayette College.

Fenwick F. Skinner (M. '16), age 85, retired New York City engineer and a resident of Sonyea, N. Y., died recently. A graduate of Massachusetts Institute of Technology, Mr. Skinner specialized in building design and construction. He was engineer in charge and field engineer for Westinghouse, Church, Kerr & Co., on construction of the Pennsylvania Terminal in New York City. He had also been assistant engineer for the New York City Department of Markets and engineering superintendent for Ballinger & Perrot of Philadelphia.

Charles H. Snow (M. '96), age 94, dean emeritus of the College of Engineering at New York University, died on October 28. Dr. Snow joined the N.Y.U. faculty in 1892, and became dean of engineering five years later. The Daniel Guggenheim School of Aeronautical Engineering was established in 1925 under his direction as part of the School of Engineering. It was the first such school in the United States. Dr. Snow

(Continued on page 113)



Harbor Freeway near Los Angeles

Looking northerly from above Olympic Blvd., showing completed freeway from Ninth St. in foreground to 4-level in background.

Designer

California Division of Highways, Sacramento, California

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CHIEF ENGINEER, M. ASCE; B.S.C.E.; age 42; post, plant or municipal engineering in a supervisory capacity, 4 years. Planning, negotiating, constructing and expediting work on military construction projects (value $100 million), including direct supervision of all area engineers, 2 years. Structural design, 5 years. Supervision of construction and installation of machinery, 6 years. Location: East or West. C-268.

SALES MANAGER, steel fabricator, A.M. ASCE; age 38; 6 years' field sales steel products; 3 years' sales manager large fabricating and machine job shop; 4 years' company representative. Location: U. S. C-269.

CIVIL AND SANITARY ENGINEER, A.M. ASCE; age 33; M.S.C.E.; registered P.E., New York and New Jersey. 11 years' comprehensive experience in water supply, sewerage and drainage facilities investigation, design and construction; U. S. and overseas; public, industrial and military works. Knows Spanish. Available as project engineer or for other supervisory assignment, U. S. or foreign location. C-270.

SALES ENGINEER (sanitary), J. M. ASCE; B.S. in C.E. (sanitary option); age 30; 10 years' experience in the design, reports, specifications, and promotion of sewage treatment and water treatment plants of latest design and use of latest equipment. East preferred, open to offer. C-271.

ENGINEERING MANAGER for commercial industrial or consulting firm; A.M. ASCE; B.S. in Civil Engineering, M.I.T.; age 36; 15 years' experience civil and structural design in industrial and consulting fields; 6 years' as chief engineer and associate in architect-engineer organization. Thorough knowledge of design, specifications, contracts and labor relations. Registered P.E. and national certification. Location desired: southern U. S. or East. C-272.

JUNIOR ENGINEER, J. M. ASCE; B.S.C.E., 1955; for past 2 years with USAF in installation engineering; desires position with best opportunities for experience leading to a P.E. license. Available January 1958. Location: optional. C-273.

CIVIL OR STRUCTURAL ENGINEER, A. M. ASCE; B.S.C.E.; age 34; 7 years' design and construction building wood, concrete and steel bridges, 3 years' design in civil and structural consulting engineer's office. P.E. license in civil and structural engineering from state of Washington. Location desired: Foreign. C-274.

SOILS ENGINEER, J. M. ASCE; B.C.E., Cornell, 1955; S.M. in C.E., M.I.T. 1956, soil mechanics specialization; age 25; 2 years' experience installation engineer, Japan; summer experience soil investigation and highway construction. Desires position with soils consultant, or teaching and research with opportunity for advanced degree. Location desired: New York City area or New England. C-276.

CIVIL ENGINEER with small consulting firm or construction company; A. M. ASCE; B.S.C.E., University of Kentucky, 1949; age 34; 3 years' experience with contractor on heavy construction; 9 years' professional experience, 4 years' in responsible field position on road and bridge construction. 5 years' design experience on expressways and bridges; presently in supervisory capacity. Registered professional engineer; commercial pilot. Location desired: Midwest or South. C-277-837-Chicago.

CONSTRUCTION SUPERINTENDENT, PROJECT ENGINEER-ESTIMATOR, J. M. ASCE; B.S.C.E.; age 32; all types of general building construction, 10 years' experience. Location desired: Foreign, Midwest or West. C-278-841-Chicago.

CIVIL AND HYDRAULIC ENGINEER, A. M. ASCE; 36, married; civil and hydraulic graduate; 5 years' design and supervisory experience in large industrial projects (Argentina); 5 years' experience as chief estimator and cost engineer for major hydroelectric developments (Brazil). Specification writer. Progress and physical completion reports. Construction schedules. Administrative and technical ability. Location desired: Los Angeles. C-279.

CIVIL ENGINEER, J. M. ASCE; graduate class of '55, University of Maryland; available June 1st, 1958 following military tour. Registered engineer-in-training, Maryland. Desires position leading to professional registration. C-280.

HIGHWAY ENGINEER, Colombian, A. M. ASCE; B.S.C.E., M.S.C.E., University of Michigan; age 46; 22 years' of sound experience in highway location, design and construction. Soils and asphalt paving. Location desired: Caribbean area or northern South America. C-281.

CIVIL ENGINEER, (structures and mechanics) M. ASCE, presently full professor at large university desires change for personal reasons having nothing to do with present position. Ph.D., 48, author of modern textbook and other publications. Correspondence invited with regard to teaching or administrative position at public or private college or university. Will consider non-engineering administrative position. C-282.

RESEARCH AND DEVELOPMENT MANAGER, M. ASCE, Ph.D. in C.E.; 40. 6 years' engineering design work petroleum refinery industry; 7 years' associate professor in civil engineering; 4 years' research and development work on blast resistant structures. Location desired; anywhere in United States. C-283.

Positions Available

CONSTRUCTION SUPERINDENT, 35-50; preferably civil graduate, with at least 10 years' supervisory experience in heavy construction and building fields. Salary, $8000-$10,000 a year plus bonus. Location: Hawaii. F-5357.

ASSISTANT PROFESSOR in civil engineering, for courses in mechanics and structures. Opportunity for research and summer work. Also opening for an instructor. Location: New England. W-5383.

CIVIL ENGINEER, Chief, graduate civil, 45-65, with a minimum of 15 years' experience in building design, layout and construction and with substantial experience in sanitation systems, with ability to advise on design of improvements and betterments to existing water supply systems in municipalities. Will review proposed designs, layouts and specifications of structures, equipment, piping and related items for economy and feasibility; check engineering programs, review contracts, etc. Salary commensurate with past earnings and experience; transportation expenses and quarters allowance paid. Climate sub-tropical. Duration, approximately nine months with possibility of extension. Location: Far East. F-5510.

WATER POWER ENGINEER to head group engaged in investigations, economic studies and designs of hydro-electric, flood control and water supply projects. Experience in earth and concrete structures, tunnels, control works, etc. mandatory. Must be willing to travel as required. Location: Southwest. W-5526.

CIVIL ENGINEERS for consulting engineering firm. Degrees and 1-5 years' design experience desired. Wide variety of interesting work in the design of water supply and distribution, water treatment, sewers, pumping station and sewage treatment facilities. Pleasant living conditions close to work in college community. Apply by letter giving references, experience, and starting salary expected. Location: Oregon. W-5538.

ENGINEERS. (*a*) Construction Project Engineer or Superintendent; 40-50; with 10 to 15 years' experience, to be responsible for the construction phase of projects concerned with industrial, metallurgical and/or chemical plants. Salary, to $12,000 a year. (*b*) Assistant to above; 30-40; with 5 to 8 years' experience. Salary, to $10,000 a year. Location: New York State. W-5542.

SANITARY AND HYDRAULIC ENGINEER, civil graduate, with at least 15 years' supervisory design and project engineering experience covering water supply sources, distribution systems and sanitary facilities. Single status. Salary, $13,000 a year. U. S. base plus 25% overseas differential for time spent outside of the U. S. Travel, transportation, quarters and subsistence provided. Company pays placement fee. Location: 9 months in Korea; 3 months in U. S. F-5544.

CIVIL ENGINEER, young, graduate, with 1 to 2 years' outside experience, preferably in foundation construction, to train for management responsibility in this type of work. Salary, $6500-$7000 a year. Location: New York, N. Y. W-5557.

HIGHWAY ENGINEER, graduate engineer, with about 15 years' experience in all phases of highway engineering. Will take complete charge and responsibility without supervision of the project consisting of a route selection study and report for a major highway. Duration: 3 months in Korea, 1-2 months in the U. S. Single status. Salary open. Travel, transportation and subsistence provided. F-5564.

CIVIL ENGINEERS with training, experience and interest in water resources development for a state natural resources council. Location: Midwest. W-5565.

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Career opportunities for men interested in professional recognition.

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Openings in Pennsylvania, Maryland, Mississippi, Ohio & West Virginia.

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In addition to our telephone work, there's a steady need for young engineers to help with our important government defense projects. The DEW Line of radar stations... the Nike guided missile system... White Alice – these are some of the important assignments the government has asked us to undertake.

The engineers who join us (mechanical, electrical, chemical, civil; physicists and mathematicians) will receive the security of a comprehensive retirement, benefit and insurance program . . . plus a chance to develop their professional skills through our Tuition Refund Plan and Graduate Engineering Training Program. Why not look into the career opportunities at Western Electric now. To apply, send resume of your education and experience to Engineering Personnel, Room 1068, Western Electric Company, 195 Broadway, New York 7, N. Y.

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Prefer several years' experience in any of these fields:

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BUILDINGS
EXPRESSWAYS
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Will consider lesser experience with good educational background. Several recent graduates will be added to our structural staffs to round out this planned expansion program. Occasional openings for combination men in construction supervision and inspection; must be free to move and to assume office duties between assignments.

Sverdrup & Parcel, Inc., are professional engineers engaged primarily in design work covering a wide scope of practice. The variety and unusual character of our work, including as an example the proposed world's largest bridge project, offer excellent opportunities for individual and professional development and advancement.

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SOILS ENGINEER, B.S. degree, for rolled earth dam—4 million cubic meters. Will supervise ten to fifteen Turkish engineers and inspectors. Must have had at least 10 years' experience in soil mechanics including experience on inspection of earth dams. Prior experience in installation embankments and piezometer equipment. Prefer single status but applicant may take wife and small family. Salary, $10,800 a year, plus allowances. Location: Turkey. F-5396.

CONSTRUCTION ENGINEER, 23-35, preferably with mechanical or civil engineering degree, but will accept individual without degree if sufficient experience; with degree, 2 years' construction drawing experience required; without degree, 5 years' experience. Will make building drawings, plant layouts and detail drawings as required for building construction and alteration. Plan and design process equipment, such as glue systems, exhaust systems, material handling equipment, etc. Salary, $5400-$6600 a year. Location: Florida. W-5401(a).

OFFICE MANAGER for foreign administration of a large contractor's office. Should have good knowledge of accounting, budgets, and costs. Knowledge of Spanish essential. Salary, $10,000 a year. Location: Europe. F-5476.

HIGHWAY ENGINEER, graduate civil, to take over the design, soils work, etc. of a system of highways in a small country in the British West Indies. Salary open. F-5478.

CIVIL ENGINEERS experienced in drainage and sewerage design. Salary open. Position permanent. Location: Massachusetts. W-5569.

SALES MANAGER for company handling diversified line with exceptional opportunity for qualified man with heavy construction equipment background. Must have knowledge of heavy construction equipment as well as sales management experience. Engineering background helpful. Headquarters: Michigan. W-5576.

CIVIL ENGINEERS with concrete design experience. Openings for prestressed concrete design, plant installation, plant management. No previous experience required in prestressing. Several locations. Headquarters: central Florida. W-5578.

Positions Announced

City of Philadelphia. The Division of Air Pollution Control and Environmental Sanitation is currently accepting applications for the positions of Public Health Engineers in the entrance and supervisory grades. Salary ranges: Public Health Engineer I, $5527-$5784 per year; Grade II, $6054-$7605 per year. Further information from Myrna J. Katin, Personnel Officer, Department of Public Health, Philadelphia 7, Pa.

Washington State Department of Fisheries. Positions are now available in the Engineering and Construction Division for: Aide, salary range $349-$414 per month; Engineer I, salary range $414-$492 per month; Engineer II, salary range $451-$537 per month. Information from Washington State Personnel Board, 212 General Administraion Building, Olympia, Wash.

City of Austin, Tex. Opening for City Planner at starting salary range of $486-$513 per month. Applicants must be between the ages of 25 and 45, and have a master's degree in planning, plus 2½ years of progressive planning experience or the equivalent. City planner will direct activities of Advanced Planning Section, and assist Director of Planning and City Planning Commission; supervise field investigations, office research and design studies. Application blanks and information from Director of Personnel, City of Austin, P.O. Box 1160, Austin 64, Tex.

U. S. Navy. Vacancies now exist for naval employment in Hawaii, Guam, and the Philippines: GS-12, Philippines, soils mechanics; GS-12, Hawaii, general, some electronics; GS-11, GS-9, Hawaii, general; GS-9, Guam, maintenance control; GS-11, GS-12, Hawaii, industrial and ordnance. Apply to Navy Overseas Employment Office, (Pacific), 45 Hyde Street, San Francisco 2, Calif.

Information received before March 15, 1958, will appear in the 1958 Directory

FOR ASCE MEMBERSHIP DIRECTORY

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ABC

Title or Position .....
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City Zone State

Send Mail and Publications to: ☐ Business Address ☐ Residence Address

Nature of Firm's Business .....
Product, Business or Service (Not for Publication)

Signature ..... **Date** .....

Deceased

(Continued from page 108)

was the author of several technical treatises and was one of the incorporators of the American Society of Mining and Metallurgical Engineers. He was graduated as a civil engineer from the N.Y.U. School of Applied Science.

Alfred L. Trowbridge (A.M. '12), age 77, chief engineer and manager of the North Kern (Calif.) Water Storage District, died on October 18. His home was in Bakersfield. Mr. Trowbridge, a civil and hydraulic engineer of note, made some of the first engineering studies for Isabella Dam, and the Southern San Joaquin Valley portion of the Central Valley Project. He was one of four district chiefs for the Central Valley Project, acting as an assistant to the state engineer. Mr. Trowbridge served for ten years as engineer and assistant comptroller of Stanford University. He had also been manager of the California Water Service.

Max P. Von Homeyer (M. '53), age 61, senior designing engineer for the Texas State Highway Department, Austin, Tex., died on August 14. Mr. Von Homeyer had served the Highway Department since 1925 as resident engineer and design engineer. Earlier he had a consulting practice, specializing in work for various Texas counties.

William Burnet Yereance (M. '08), age 91, retired consulting engineer, died in Albany, N. Y., on August 8. Early in his career, Mr. Yereance worked in various capacities for the New York Central, West Shore, Lackawanna, Brooklyn Elevated, and Brooklyn Rapid Transit. In his first private consulting practice, he specialized in public utilities. He was a graduate of Stevens Institute.

Recent Books

(Continued from page 27)

Corrosion And Wear Handbook For Water-Cooled Reactors

The first part of this handbook includes general discussions on the nuclear reactor plant and its relation to conventional power plants, considerations in choosing materials, fundamentals of corrosion and wear, and water technology. The second part provides tabulated data and detailed reference information on methods of testing and on the corrosion and wear resistance of various materials in different environments. The last part deals with special problems such as crevice, stress, and intergranular corrosion, system corrosion deposits, wear, and manufacturing problems. The book, edited by D. J. De Paul, is one of a series sponsored by the Naval Reactors Branch of the Atomic Energy Commission. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1957. 293 pp., $6.00.

Basic Soil Engineering

This book by **B. K. Hough** provides broad coverage of the fundamentals of soil properties and the engineering behavior of soils, and explains, from the practical viewpoint, the application of this information to common problems in foundations, earthworks, and highway and airfield engineering. The book is intended to serve as an undergraduate text and as a reference for practicing engineers without formal education in the subject. The Ronald Press Company, 15 East 26th Street, New York 10, N. Y., 1957. 513 pp., $8.00.

Top Photo: Suter, Hedrich-Blessing. Lower Photo: Billy Hope. Courtesy of Howard Andrews, Supt. of Schools, Kellogg, Idaho. Architects & Engineers: Culler, Gale, Martell & Norrie, Spokane, Wash.; Perkins & Will, Chicago, Ill., White Plains, N. Y.

Kinnear Rolling Doors

This striking new high school at Kellogg, Idaho, presents architectural progress at its best. Right at home in this modern setting are six Kinnear Rolling Fire Doors, like the one at right — with the interlocking steel-slat curtain originated *by Kinnear* nearly 60 years ago. Like the school itself, these doors owe much of their eye appeal to basic, functional efficiency. In case of fire, they lower *automatically*, blocking the spread of flames. Positive, spring action starts them, yet downward speed is *controlled* for safety. And they can be opened after automatic closure, if necessary. For extra fire protection plus highest safety for building occupants install Kinnear "AKBAR" Rolling Fire Doors (labeled by Underwriters Laboratories, Inc.)

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Non—ASCE Meetings

American Concrete Institute. Annual Convention at the Morrison Hotel, Chicago, Ill., February 24-27. For information write the American Concrete Institute, P.O. Box 4754, Redford Station, Detroit 19, Mich.

American Road Builders Association. National Convention at the Sheraton-Park Hotel, Washington, D. C., January 20-23. For information write ARBA, World Center Building, Washington, D. C.

American Society for Engineering Education. 1958 College-Industry Conference, at the University of Michigan, Ann Arbor, Mich., January 30-31. Details from University of Michigan, College of Engineering, 255 West Engineering Building, Ann Arbor, Mich.

Georgia Institute of Technology. Seventh Georgia Highway Conference at Georgia Tech, Atlanta, Ga., February 24-25. Contact Richard Wiegand, Director, Short Courses & Conferences, Georgia Institute of Technology, Atlanta, Ga.

Highway Research Board. Thirty-Seventh Annual Meeting at the Sheraton-Park Hotel, Washington, D. C., January 6-10. Information from the Highway Research Board, National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D. C.

University of California. Tenth Annual California Street and Highway Conference, co-sponsored by the University Extension and the University's Institute of Transportation and Traffic Engineering at the Los Angeles campus of the University of California, January 29-31. Information from the University.

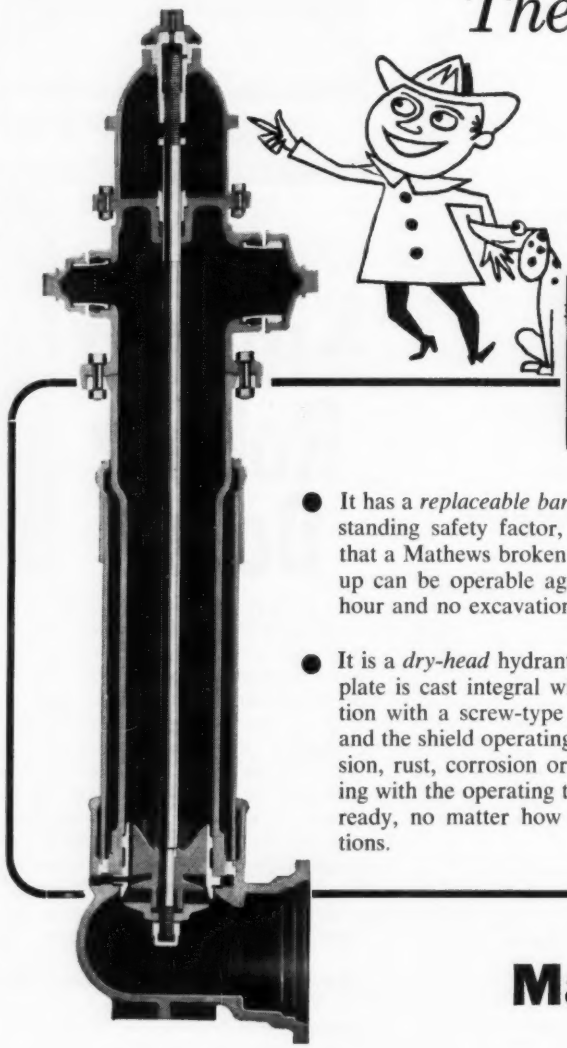
Applications for Admission to ASCE, Sept. 30—Nov. 2

Applying For Member

JASPER WILLIAM AVERY, Cleveland, Ohio.
FREDERICK BENJAMIN BARKALOW, Washington, D. C.
THOMAS GRAYSON CAMPBELL, JR., San Rafael, Calif.
CHO HEN CHUN, Hilo, Hawaii.
HAROLD MARION CROWELL, Baghdad, Iraq.
ALEXANDRE DIMITRI DE NAGLOWSKY, New York, N. Y.
JOSEPH JOHN DUFFY, New York, N. Y.
CHARLES WESLEY MCKENNON, JR., San Antonio, Tex.
JOHN ANTHONY DILLARD, JR., Houston, Tex.
FRANK ALLEN FOSS, Keyport, N. J.
ROBERT EDWARD FOY, Martinsville, Va.
THOMAS NORBERT HERON, Greenville, Miss.
CLARENCE CHARLES HINCHBERGER, Corpus Christi, Tex.
RAY ERNEST HOLMES, Portland, Oreg.
CHARLES EDWARD JACOI, Northridge, Calif.
CHARLES DOUGLAS KAEFER, Fair Lawn, N. J.
THOMAS TOWNSEND MANN, Roswell, New Mex.
WILLIAM MARTIN, New York, N. Y.
KIRK CRAWFORD MCFARLAND, JR., San Jose, Calif.
ROBERT BRUCE MCRAE, Denver, Colo.
ROLAND HAROLD MOORE, Chevy Chase, Md.
VIRGIL MILTON OLFE, Chicago, Ill.
EDWIN STANTON OSLER, Lexington, Ky.
THOMAS HILTON REID, Honolulu, T. H.
ISHAK ALI RIDA, Amman, Jordan
ERNEST CHARLES ROEMER, Tallahassee, Fla.
KARTIK CHANDRA ROY, Wad-Medani, Sudan
ALBERT EDWARD SANDERSON, Boston, Mass.
CHARLES EARL SHIRLEY, Baghdad, Iraq.
ERNEST LAVERNE STOCKTON, San Mateo, Calif.
JOHN THOMAS STOFKO, New York, N. Y.
JAN JOSEPH TUMA, Stillwater, Okla.
JOSEPH A. WALSH, JR., New York, N. Y.
HARRY M. WARTUR, New York, N. Y.
CHARLES CHUN CHU WONG, Singapore, China
GEORGE WALTER ZALITE, Glendale, N. Y.

MATHEWS

The finest



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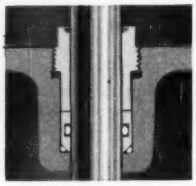

- It has a *replaceable barrel*. This is an outstanding safety factor, because it means that a Mathews broken in a traffic smash-up can be operable again within half an hour and no excavation is necessary.
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Edward Borysiewicz, Oceanside, N. Y.
Percy Clayton Bryant, Roanoke, Va.
Farland Clay Bundy, Austin, Tex.
Selig Lester Clarke, Orange, N. J.
Richard Hudson Clough, Albuquerque, New Mex.
Hershel Curtis Duke, Atlanta, Ga.
Helen L. Eyinck, Fairbanks, Alaska.
William Davis Flye, Bogota, Columbia.
Robert Kent Freer, Philadelphia, Pa.
John Charles Giese, Clarksburg, W. Va.
Herbert Globig, New York, N. Y.
Genri Gulbinowicz, New York, N. Y.
Philip Charles Hansen, Knoxville, Tenn.
Jack C. Hacker, Orange, N. J.
Marcy Hanft, East Meadow, N. Y.
Frederick Henry Haidt, Jr., Mobile, Ala.
Russell L. Hale, Rollo, Mo.
Lt. Col. Nasiruddin Humayune, Rawalpindi, West Pakistan.
Edward Everett Jackson, Alhambra, Calif.
Apostle Johnson, Cleveland, Ohio.
Henry Ole Johnson, Glenview, Ill.
Janusz Kaller, Vancouver, B. C., Canada.
Patrick Hughes Keefe, Jr., Victoria, Tex.
Donald William Kirk, Fort Worth, Tex.
Nimmagadda Lakshiminarayana, Kurnool, South India.
Richard Edwin Landau, Middle Village, N. Y.
Wa Joong Lum, Honolulu, T. H.
William Augustine Manware, Aiken, S. C.
Emmett Charles Mascheier, Vicksburg, Miss.
Paul Gustav Wilhelm Mayer, Ithaca, N. Y.
James Baker Miller, Fort Worth, Tex.
Martin Luther Moody, Jr., Boulder, Colo.
Kenneth Bernard Morrissey, Baghdad, Iraq.
George Alexander Ozerov, Trenton, N. J.
Joseph Anthony Paduana, New York, N. Y.
George Thomas Popov, San Francisco, Calif.
Reid Harold Potter, Portland, Me.
Robert Dewey Ramsey, Jr., Tullahoma, Tenn.
Abdur-Rahman Salih Rasul, Baghdad, Iraq.
Mohammed Abdur Razzack, San Francisco, Calif.
Pasqualino Salvo, Queens Village, N. Y.
Edward Albert Scott, Oak Ridge, Tenn.
Earle Lawrence Slyder, Phoenix, Ariz.
Harry Jack Spitzer, Melrose Park, Ill.
Jerry Annaldo Steding, Atlanta, Ga.
Joseph Stein, New York, N. Y.
Calvin Lee Stempel, Panama, R. de Panama
Gilbert Tattersall, Alhambra, Calif.
Richard Clarence Thomas, Westlawn, Pa.
Vaughan Elvin Tippit, Paola, Kans.
Hasan Tahsin Ugurlu, Samsun, Turkey.
Lalpet Venkatesan, Madras State, India.
Dennis Vickers, Savannah, Ga.
Gideon Pieter Retief Von Willich, Pretoria, South Africa.
Lester Charles Webb, Jr., Kansas City, Mo.
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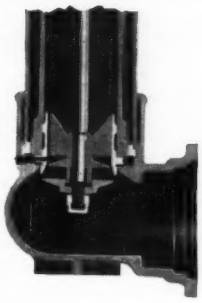
If you sat down and checked off the features that a well-designed hydrant ought to possess, you would find yourself describing a Mathews Modernized Hydrant



- The main compression-type valve opens *against* water pressure. The higher the pressure, the tighter the valve—a positively leakproof construction.
- **OTHER QUALITY FEATURES**

The operating thread cannot be bent. Head revolves 360°. Nozzle sections can easily be changed. Nozzle level can be raised or lowered without excavation. Bell, mechanical-joint or flange-type pipe connections.

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Norman Harold Reece, New York, N. Y.

Applying For Junior Member

Jaime Augusto Acevedo Parra, Baton Rouge, La.
Eugene Arthur Belongie, Glendale, Calif.
Leonard Simpson Brown, Jr., Freeport, Tex.
Floyd Lionel Caplan, Cleveland, Ohio.
Anthony Joseph Carlesi, New York, N. Y.
George Dean Cleveland, Freeport, Tex.
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Johan Koiva, Hartford, Conn.
Bernardino Espinosa Lopez, Bolivia, S. A.
James John Morgan, Urbana, Ill.
Fuad Sami Nuwaysir, Bethlehem, Pa.
Rafael Enrique Pacheco-Fontana, Caracas, Venezuela.
John Charles Pierchoski, Palmyra, Pa.
Paul Stewart Quigg, Chicago, Ill.
Shlomo Ami Ravid, Upper Darby, Pa.
Tony Melville Ridley, Essex, England.
Pedro Rona, Parana, Brazil.
Richard William Scholtes, South Bend, Ind.
Robert Dean Steed, Alberta, Canada.
Maung Aung Su, Burma, China
John Variakojis, Chicago, Ill.
Ralph Eugene Voice, Jr., Fresno, Calif.
Charles Frederick Walters, West Lafayette, Ind.
James Ting-Shun Wang, Lawrence, Kans.
Richard Junior Wasley, San Leandro, Calif.
John Malcolm Wigham, Alberta, Canada.
Sam L. Yaker, Toledo, Ohio.
Yee Fong Young, San Francisco, Calif.

[Applications for Junior Membership from ASCE Student Chapters are not listed.]

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Conveyor—205-ft Long.

Abrasive Aggregate Handled On Hamilton Belts

AN INGENIOUS 688-FT CONVEYOR system enables one of the country's largest ready-mixed concrete plants to produce at the record rate of 200-cu yd per hr. From the delivery of basic materials in self-unloading ships, to that of the finished concrete in shining truck mixers, the system permits super-fast handling of materials to meet the mixing plant's requirements. Materials are handled in this manner: Crushed stone, for coarse aggregate, and lake sand, for fine aggregate, are unloaded in separate piles from ships equipped with special 200-ft long conveyors. The 11,000-ton shiploads are discharged at a rate of 2,000-tph to the plant's storage areas. When needed, these aggregates are fed into the four bins located along the dock. They in turn feed onto two Hamilton Conveyor belts traveling parallel to the dock line and discharging into collecting hopper at the junction point.

No. 3, 96-ft long, operating in a tunnel, receives the discharge of materials, and carries it to the underground hopper for the main conveyors, where No. 4 takes it and raises it to the top of the 150-cu yd four-compartment bin. If the material is not diverted into one of the bin's compartments, it continues upward on No. 5 conveyor, 162-ft in length, to the top of the batching plant, which is 105-ft above ground. Here, a radial discharge spout empties it into any one of six compartments. At the upper level of this plant, which is only 54-ft by 30-ft in plan area, are two storage bins—one a three-compartment, 3000-bbl capacity steel bin for storing cement, and the other, the six-compartment, 450-cu yd steel bin for storing aggregate. The cement comes to this bin by means of a cement screw. From here, the concrete is batched electronically by weight and dropped into the waiting mixer-trucks for delivery to the customer. **Acme-Hamilton, CE-12, 51 Meade, Trenton 3, New Jersey.**

Armour Tests Tell Results On Econo-Lok

ARMOUR RESEARCH FOUNDATION of Illinois Institute of Technology has just completed some studies on the possibility of eliminating the troublesome header course in two wythe masonry wall construction. These studies were sponsored by AA Wire Products Company of Chicago, who manufacture a masonry reinforcement designed "to control shrinkage cracking in concrete masonry wall." Preliminary results indicate that not only can the header be eliminated, but greater lateral strengths can be attained by the use of reinforcing masonry ties of the proper design, the firm reported.

"Starting with the assumption that the most common type of two wythe wall is one consisting of concrete block backup and face brick facing, and that there is a difference in the coefficient of expansion and contraction between these two units, due to changes in moisture content, the manufacturer designed a combination reinforcement and tie which tends to control this difference. The new reinforcing masonry tie which is marketed under the trade name of Econo-Lok, provides two parallel reinforcing wires which are designed to rest on the face shell webbing of the concrete block backup. Flush welded to these parallel reinforcing wires are four-inch wide rectangular ties every sixteen inches which tie the backing to the facing.

"Armour Research Foundation conducted transverse loading and compression loading tests on control panels of concrete block backup and face brick veneer, tied with a continuous brick header every sixteen inches vertically. When transverse loadings were applied, the modulus of rupture on header tied walls was 31-psi, and on wire tied walls the modulus of rupture was 77-psi. The wire tied wall more than doubled the lateral strength of the brick header tied wall.

"When compression loads were applied, the header tied walls failed at an average loading of 875-lb per sq in. The wire tied walls failed at a loading of 678-lb per sq in. The large difference in lateral strength between the header and wire tied walls must be attributed to either a weakness in the header, additional strength from the wire design or a combination of the two.

"The most logical explanation being that the header weakens the wall in transverse stress by creating a point of stress concentration and often a point of cleavage. The wire design used eliminates this weakness and provides additional shear strength to the hollow unit backup. Statistically, the slight drop in compressive strength in the Econo-Lok tide wall is of no real significance. However, a possible explanation could be a weakness in bond strength or the presence of a number of weaker masonry units present in the wire tied panels but not present in the header tied panels," the firm explained. **AA Wire Products Co., CE-12, 714 East 61 St., Chicago 37, Illinois.**

New Method Of Sun Control

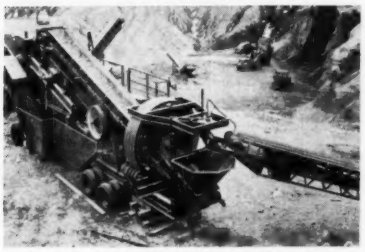
STANDARD PANELS OF GRATING for use as sunshades on school buildings and other structures which often require large glass areas for natural lighting, have been made available. They can substantially reduce cooling costs of completely air-conditioned buildings by preventing the intense rays of the sun from generating excessive heat on window glass. Hot air cannot become trapped next to glass; it circulates freely through the open mesh of the grating. Also helping to control sky glare from direct sunlight while admitting the maximum amount of daylight, it offers maintenance advantages, as it will not collect rain or snow. The trim straight lines blend beautifully with modern architectural ones. **Irving Subway Grating Co., CE-12, Long Island City 1, New York.**

EQUIPMENT MATERIALS and METHODS

(continued)

Hydraulic Drive System

IN AN EFFORT TO FIND better and lower cost ways of crushing and processing rock and gravel along with easier mobility and maintenance, an optional hydraulic drive system for portable crushing and conveying units for pit and quarry use has been developed. Smoother and more simple in application, this method of driving lessens vibration, noise, maintenance, and improves power transmission with a steadier, more level, fluid application of horsepower. This, plus containment of power within the driving mechanisms themselves without the loss of power in vibration transmittal and degeneration to substructures, makes this method not only more self-sufficient, but tends to have less wear and tear on plant mountings. The drive works by oil pumped through flexible pipe lines from a reservoir tank to hydraulic motors mounted individually as driving units on the various plant components. Return lines bring the oil back to the reservoir tank. Pressure is constantly and automatically regulated to provide whatever power is required for each drive. This gives the smooth steadiness and regulated conservation of power that makes this drive so efficient. **Lippmann Engineering Works, Inc., CE-12, 4603 W. Mitchell St., Milwaukee 14, Wisconsin.**



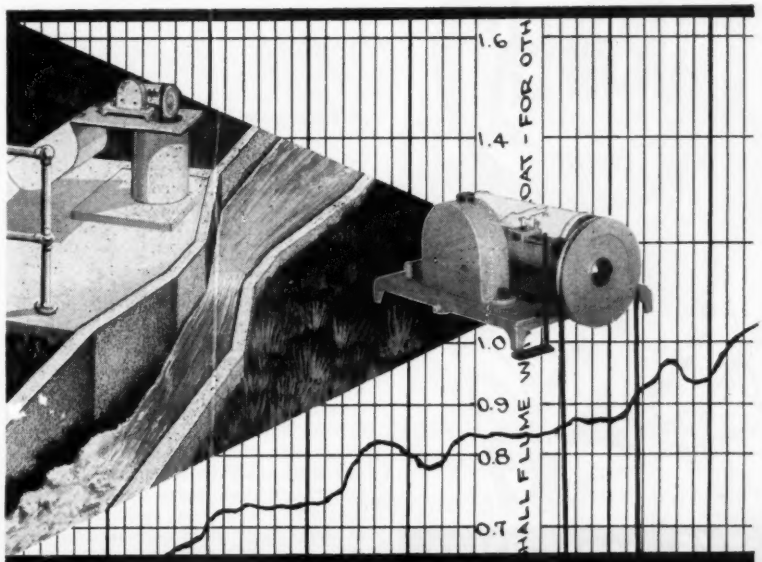
Dual Crushing Plant

Magnesia Insulation Installed 10 Years 89% Reusable

BY SALVAGING USED PIPE insulation, a contractor held down the cost of a recent construction project. Old sectional magnesia insulation was salvaged from relocated steam lines and reinstalled on new lines. About 89% was still in good enough condition after 10 years' service to be reused on the new installation.

(Continued on page 118)

NOW Low-Cost Automatic Flow Recording



STEVENS Type F Recorder

For Measuring Sewage, Industrial Waste and Other Flows

Flow charts directly readable in million gallons per day or gallons per minute over various sizes of Parshall flumes. The same recorder can also be used with charts reading in feet and hundredths to record head or surface fluctuations in lakes, streams and wells. Priced from $132. Write for free Bulletin 24.

The planning and efficient operation of any project which involves measurement of flowing liquids is based on flow data which can be obtained with STEVENS Water Level Recorders. STEVENS instruments are at work compiling data on hydro-electric and flood control projects and in water works, sewage disposal plants, irrigation and industrial installations in all parts of the world.

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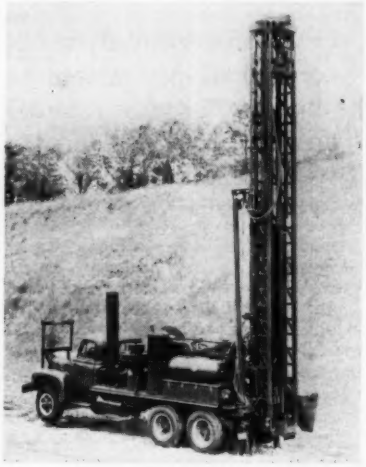
EQUIPMENT MATERIALS and METHODS

(continued)

The other 11% was not reusable only because of breakage due to dismantling and handling. In addition, 56% of segmental insulation from the old 12-in. lines was also reusable. **Ehret Magnesia Manufacturing Co., CE-12, Valley Forge, Penna.**

Truck-Mounted Rotadrill

A NEW, DIESEL-POWERED, truck-mounted rotary drill that makes holes faster and lowers the costs has been announced. Under constant drilling operations, fuel consumption is reduced as much as 70% in comparison with units employing a compressor driven by the truck's gasoline engine. Savings are greatest for large quarry operators, water-well drillers, and contractors who have available supplies of diesel fuel. Field reports show that this unit makes holes 600 to 700% faster than is possible with the best churn drilling techniques. The engine, an International Harvester UD 1091, is direct-coupled to a Schramm air compressor



Holes drilled to 700-ft with 4½-in. drill pipe

with no connection to the truck engine. Hydraulic pumps, the oil cooling system, and dust collecting fan are all driven by the diesel engine. Normally, the compressor delivers 450-cfm at 20-psi. However, for dewatering or breaking out blockages, air pressure can be boosted to 200-psi. **Schramm, Inc., CE-12, 900 East Virginia Ave., West Chester, Penna.**

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EQUIPMENT MATERIALS and METHODS

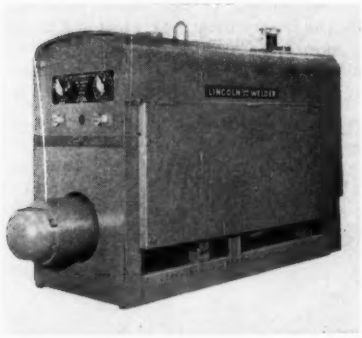
(continued)

Teflon-Sleeved Stainless Steel Plug Valves

STANDARD TUFLINE TWO-WAY stainless steel plug valves have now been adapted to a bottom-entry three-way design designated Series 36 (screwed end) and Series 37 (flanged end). Various plug passage arrangements are available to suit user requirements. Among these are "L" or "T", with shut-off, and a non-shut-off version. Also available are special plugs for line sampling or dumping of residues. **Continental Mfg. Co., CE-12, Cincinnati 36, Ohio.**

Portable ARC Welder

A NEW MODEL OF THE gasoline engine-driven portable arc welder has been announced. It is NEMA rated 200 amperes at 40 volts and 60% duty cycle, has dual controls for the generator output, an electrical outlet providing 1-kw of auxiliary DC power, an idling device, and is powered by a 36-horsepower water-cooled engine. It includes a five step selective current control and a continuous voltage control which also provides fine adjustments in the current. The ranges of the steps on the selective current control overlap, so that it is possible to obtain either a high or a low open circuit voltage for any current, thereby selecting the type of arc most appropriate for the work. A high compression head Continental F-162 gasoline engine that drives the welder develops 36-horsepower at the 1450-rpm operational speed of the welder. Its output is said to exceed the normal demands of the generator and provide reserve power for smoother and more responsive operation and extend the life of the welder. **The Lincoln Electric Co., CE-12, Cleveland 17, Ohio.**



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SERVICISED "CEMENTONE"®

SPONGE RUBBER JOINT FILLER

★ Non-Extruding...High Recovery After Compression

★ Weather and Rot Resistant

★ Gray Color Blends With Concrete

"Cementone" is a High Density Material, Especially Designed for the Construction Industry

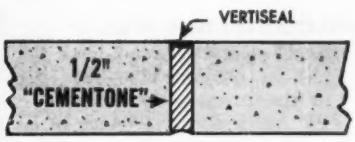
Servicised "Cementone" Sponge Rubber is a maximum performance joint filler, designed for applications where utmost resilience, non-extrusion, high recovery, material stability and resistance to the deteriorating effects of weather, mildew and rot are required. It is also widely used in exposed architectural concrete such as bridges and overpass structures, abutments, walls, etc. where its neutral gray color blends well with the color of concrete.

Because of its compressibility, high resilience and color, "Cementone" is ideally suited for use in tilt-up construction at vertical column and panel butt joints. (below)

Made from high quality blown sponge rubber, uniform in thickness and density, "Cementone" is available in cut strips or sheets in standard thicknesses of ¼", ⅜", ½", ¾" and 1" in lengths up to 10 ft. For greater thicknesses, "Cementone" may be laminated.

Typical "Cementone" Tilt-up Applications

"Cementone" Sponge Rubber used on wall sections with column vertical joint.



Sealing a butt joint of precast wall panels. Vertiseal is used to seal the exterior face.

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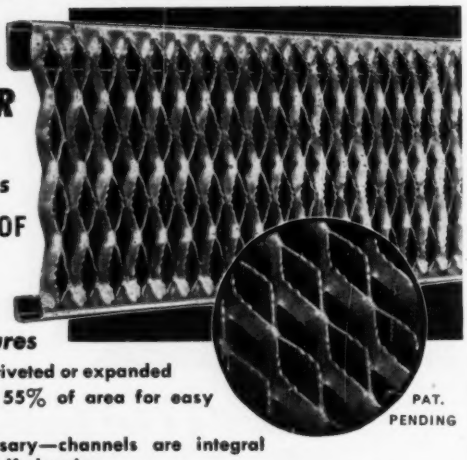

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★ All one piece, not welded, riveted or expanded
★ Open space in excess of 55% of area for easy access of light and air
★ No extra supports necessary—channels are integral part of the material. ★ Self cleaning
★ Cut and installed like lumber by your own maintenance force. ★ Low in original cost. ★ For balconies, no secondary sprinkler heads needed

PAT. PENDING

Ideal for work platforms, stair and ladder steps, flooring, balconies, catwalks, machinery guards, fire escapes and for original equipment safety treads.

2 GOLD NUGGET® WELDED grating
PAT. PENDING

The QUALITY GRATING for Heavy Duty Applications

★ 3/16" projection weld nugget for greater rigidity and strength
★ Vertical alignment of the main load bar assured
★ All bars are load carrying bars including secondary bars
★ Anti-skid pattern

PROJECTION WELD

Each secondary load bar (A), as projected welded to the primary load bar (B) has a shear strength of 5,000 pounds per weld. There are 28 such projection welds to a square foot of grating. This means that GOLD NUGGET Welded Grating can sustain greater shock loads than other gratings.

For the complete details of these revolutionary new gratings, write for new catalogs today. Distributors in all principal cities. Consult the yellow pages in your phone book under "GRATING".

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EQUIPMENT MATERIALS and METHODS

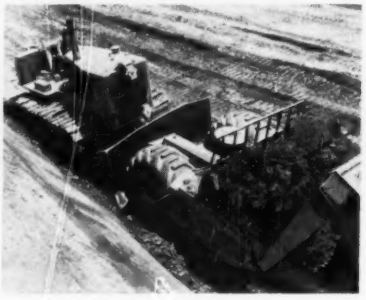
(continued)

Multi-Purpose Sealing Compound

A SYNTHETIC RUBBER CAULKING and sealing compound developed to meet the needs of today's increasingly popular curtain and panel wall construction, has been introduced. Called Sonolastic Sealing Compound, it is a liquid made up of sulfurized rubber polymers furnished with an activating agent which cures the liquid to a rubber-like substance after it is introduced to the joint to be sealed. The compound thus becomes a resilient part of the joint structure for the life of the building. The sealing and caulking product is non-shrinkable and impervious to the effects of air, moisture, salt spray and sunlight. The material possesses the property of "cold flow" and complies readily with distortions of panels caused by extremes of temperatures. The new product has been thoroughly tested under field conditions and found to measure up to all needs. Beads approximately 3/8-in. deep and 1/2-in. wide can be stretched to four times their width without damage to adhesion or continuity. **Building Products Division of L. Sonneborn Sons, Inc., CE-12, 404 Fourth Ave., New York 16, N. Y.**

Pusher-Dozer-Ripper

AN INSIDE MOUNTED BULLDOZER with features making it efficient for loading scrapers, heavy duty bulldozing and back ripping, has been announced. It has a cutting width of 10-ft 2-in. which clears the width of the tractor. The blade is

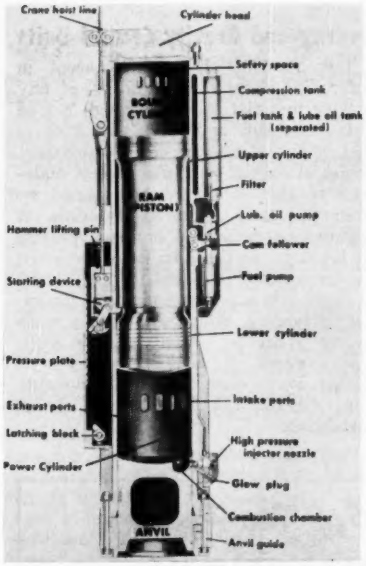


For D9 Tractor

¾-in. thick with a ¾-in. push plate reinforcement on the back. The rugged box-welded construction, the 1¼ x 12-in. cutting edge and the Cat No. 9S end bits make it an ideal rock dozer because the narrow width allows more unit force on the cutting edge. The company uses another auxiliary manufacturer's product, the Preco Back-Ripper, as an optional attachment at extra cost. Two or three rippers may be built-in at the factory at time of fabrication. **Balderson Inc., CE-12, Wamego, Kansas.**

Diesel Pile Hammer

THE TREND TO DIESEL POWERED pile hammers has been accelerated by the introduction of one which is easily transportable, completely self-contained, needs no auxiliary equipment and is one-man controlled. It eliminates the need for costly compressors, boilers, high-pressure hose, fresh water supply and other equipment required for conventional air or steam hammers. Able to transform any power crane economically into a pile driver, a single cable to hoist the hammer into the leads in which it operates, is all that is necessary to



Requires Little Maintenance

position it. Working on the two-cycle principle, energy is delivered to the pile head, through the anvil, in three stages —pre-load, impact and explosive force. Unlike the conventional diesel pile hammer in which the ram or piston is free to rebound beyond the top of the open cylinder head, it incorporates a closed cylinder top which traps and compresses air to form an "air spring," which limits the upward travel of the ram and accelerates it downward, enabling the hammer to obtain more blows per minute. **Link-Belt Speeder Corp., CE-12, Cedar Rapids, Iowa.**

Power Steering Available For Pneumatic Line

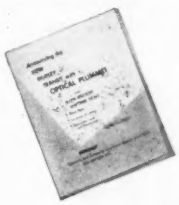
POWER STEERING FOR THE Hyster series of pneumatic-tired trucks in the 3000, 4000 and 5000-lb capacity range is now available as optional equipment. The features of these machines include large pneumatic tires for good traction in both inside and outside operations, a dual-tired trunnion steering assembly and

(Continued on page 122)

New Optical Plummet Built into Gurley Transit Saves Set-up Time, Improves Accuracy on Windy Days

Years ago, Gurley introduced lightweight instruments to combat wind vibrations. Now Gurley further beats the wind problem with an optical plummet *built into* the instrument.

The new Gurley Optical Plummet Transit eliminates swing and sway of the cord and plumb—always time-consuming and exasperating on a windy location, and inaccurate as well. Positive accuracy of set-up is assured with the Gurley Optical Plummet.



The new Gurley transit is furnished with a tripod with built-in shifting head, and allows a two-inch shift of the instrument over the point. This provides greater latitude in initial set-up.

Gurley's new Optical Plummet Transit offers one of the advantages of the optical-reading theodolite *plus* the desirable features of simplicity and universal acceptance of the American transit. For further details, write for Bulletin OP-57.

GURLEY

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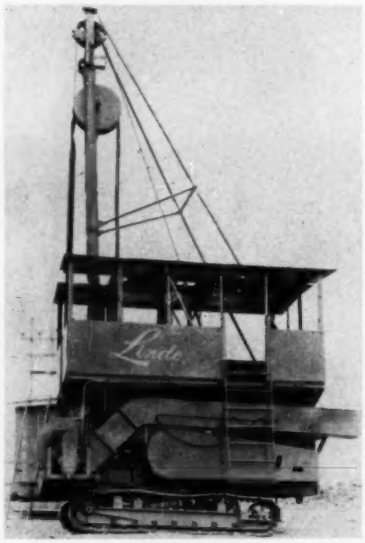
(continued)

modern functional design styled by Henry Dreyfuss. A full range of options, attachments and accessories is available, such as "Load-Grab" clamps, revolving aprons, booms, fork extensions, side-shift aprons, dual drive wheels and many others. Fast, immediate and dependable steering action is assured because of the use of a flow divider in the hydraulic system that always directs fluid first to the power steering unit. **Hyster Company, CE-12, Danville, Illinois.**

Jet-Flame Process Pierces Toughest Rock

THE ROCKET JET PRINCIPLE used to power our modern jet aircraft and missile weapons is now being put to industrial use. On the gigantic St. Lawrence Seaway project, blast holes are being sunk in rock with a flame process known as Jet-Piercing. Working on the rocket principle, it is possible to pierce rock at speeds up to ten times faster than conventional drilling methods. Intensely hot, supersonic jets of flame are the key to the new process. Traveling five times faster than the speed of sound, the flame spits out of a rocket-type burner and disintegrates or spalls the rock in its path. This is a continuous operation. Disintegrated rock particles are thrown up out of the hole by the combined force of burning gases and steam so that a fresh surface is continually exposed to the jet flame. The only limitation to penetration depth is the length of the hoses (carrying fuel, oxygen, and water) that are lowered into the hole. Deepest penetration obtained to date is 160-ft. **Linde Company, Div. of Union Carbide Corp., CE-12, 420 Lexington Ave., New York 17, N. Y.**



Reaches 4000-Deg F.

Density and Gravity Control Units

THE JSP-173A IS a new concept in controlling density and gravity of any process material passing through a pipe either vertically or horizontally. A novel feature is that no part of the equipment comes in contact with the process materials so that it cannot be affected by even the most corrosive materials. It requires no drilling of holes or welding of brackets, and can be easily removed for use in another location when desired. It eliminates sampling and costly laboratory diagnoses. When used with a satisfactory controller, it will provide accurate control of density and gravity within very close limits. **Instruments, Inc., CE-12, 122 N. Madison, Tulsa, Oklahoma.**

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THE WORLD'S FINEST
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Literature Available

The following literature is offered by exhibitors at the first ASCE Civil Engineering show.

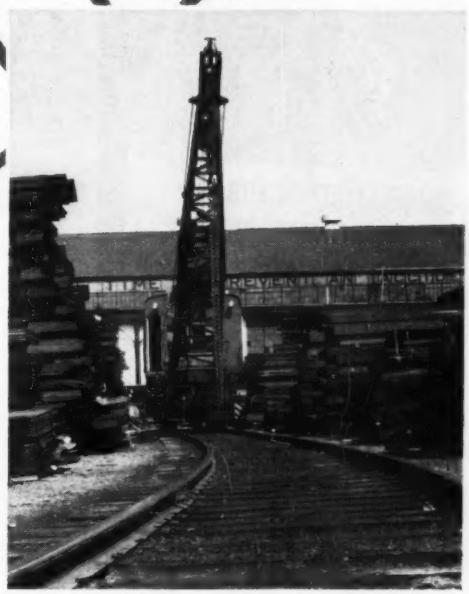
PACKSACK DRILL—Bulletin 100 describes in detail the new lightweight (32-lb), fully portable gasoline powered diamond core drill. It is available with a separate, completely self-contained pumping station as well as a kit of tools and accessories to core to depths of 50-ft with standard rods and 100-ft with aluminum ones. Included in the pamphlet are specifications and a description and pictures of the Packsack in action. **Acker Drill Co., Inc., CE-12, Scranton 3, Penna.**

PHOTO CONTOUR MAP—Well designed to suit the needs of engineers, geologists, and foresters, the Photo Contour Map described in a new pamphlet, is an orthographic projection showing both contours and complete air photo detail. Not a mosaic with contour lines superimposed, detailed corrections are made for tilt, topographic relief and scale for each photograph. The map is extremely useful when one considers such advantages as reduction of drafting time up to 50%, photographic reproductions to the scale required from one negative, and self-checking through visual inspection. **Aero Service Corp., CE-12, Philadelphia, Penna.**

PHOTOGRAMMETRY—A highly interesting and informative 15-page booklet entitled "Photogrammetry in Engineering and Allied Fields," explains that the relatively new science reduces the number of man-hours and overall time by producing maps essential for most exploration, engineering, and development operations. It points out that this process supplements, not replaces, the service of surveyors and engineers, and can be designed to keep within a client's requirements and economic limitations. Seven full page maps show a few of the company's mapping projects. **Jack Ammann Photogrammetric Engineers, Inc., CE-12, Broadway at Tenth St., San Antonio, Texas.**

STEEL BUILDINGS—Frameless steel buildings that simplify building problems is the subject of a revised 6-page folder, SX-13857. Utilizing the Steelox panel both for structural support and exterior finish in a single unit, they come in a wide range of sizes, are quickly erected at low cost, and provide permanence and neat, clean appearance. **Armco Product Information Service, CE-12, Middletown, Ohio.**

Life Line of Industry



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West Virginia Trackwork

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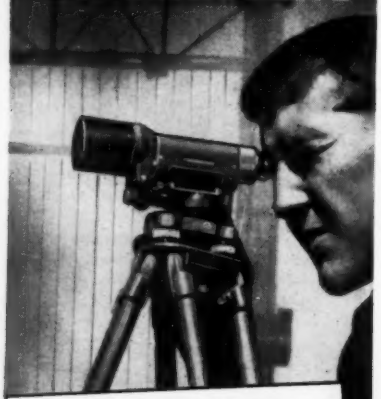
KERN
INSTRUMENT



WORLD FAMOUS
precision surveying instruments... compact, rugged construction... fast, effortless operation. More reliable results in less time.

KERN'S NK3
precise level
in use at Gloucester Anchorage of new Walt Whitman Bridge being constructed over Delaware River. (Modjeski & Masters, Ammann & Whitney, Consultants to the Delaware Bridge Authority of Pa. and N. J.)

DESIGNED FOR HIGHEST PRECISION LEVELING

- Functional, down-to-fundamentals design—only 4½ lbs. (6 lbs. with carrying case).
- Coincidence level and fine tilt screw.
- Readings at a glance—level and rod may be read simultaneously through 30x Telescope.
- Mean leveling accuracy under normal conditions ± .008 ft. per mile.
- Kern AR coated optics produce substantial increase in brilliance and contrast of image.

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KERN INSTRUMENTS INC.
120 Grand St., White Plains, N.Y.

Literature Available

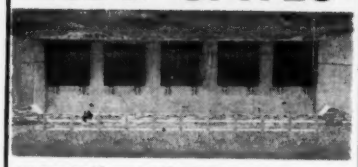
PORTABLE DEPTH RECORDER—A 4-page description of the Model E.S.-130 Portable Depth Recorder is now available. Complete with pictures and specifications, the pamphlet points out that the unit will operate from a 6 or 12 volt D.C. (nominal) power source or from 115 volt A.C., 60 cycles, requiring less than 40 watts of power. It may be operated from a 6 or 12 volt (nominal) small boat electrical system with either battery terminal grounded without causing deleterious equipment performance or introducing operating personnel electric shock hazards. The complete equipment, less power source, weighs less than 40-lb. It has a depth range to 245-ft with four scale ranges of 65-ft each displayed on recorder paper with 7-in. of useful range. It will plainly record a depth within 2-ft of the transducer face. All parts are accessible for easy servicing and no special test equipment is required for maintenance. **Bludworth Marine Div. of Kearfott Co., Inc., CE-12, 1500 Main Ave., Clifton, New Jersey.**

DEGRITTING CLARIFIER—The many advantages of the degritting clarifier such as mechanical grit removal based on area consideration, elimination of separate grit collecting facilities, and maximum digester capacity utilization by grit elimination, are described in a new brochure. Two drawings showing the sectional elevation of the clarifier and typical grit handling facilities using hand operated diaphragm pump and decanting box, are included. **Dorr-Oliver, Inc., CE-12, Barry Place, Stamford, Connecticut.**

TEST KIT AVAILABLE—To draftsmen only. A test kit is being offered which will give visible proof of the durability, smoothness and erasability of the Turquoise drawing pencil. **Eagle Pencil Co., CE-12, 703 East 13th St., New York 9, N. Y.**

SURVEY DEPTH RECORDER—According to a new bulletin, the Model 255 Survey Depth Recorder consists of three components: recorder, one transducer mounted in the hull or over the side, and a portable power converter. Housed in a cast aluminum case 18½-in. long, 13½-in. high, 9½-in. deep, and weighing approximately 60-lb, it includes a hinged recording mechanism, belt drive motor, and electronic chassis. The equipment is readily installed to operate aboard survey vessels of all types traveling at any speed up to 15 knots and in any water depth from 3-ft to 250 fathoms. **Edo Corporation, CE-12, College Point, New York.**

TIDE GATES



FIVE 96″ x 96″ TYPE M-M-T TIDE GATES INSTALLED NEAR WILKES-BARRE, PA.

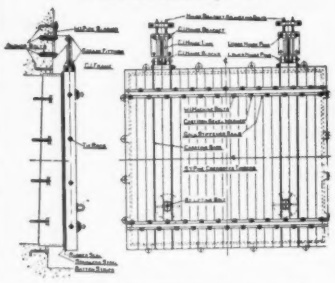


FIG. 9320 SHOWING TYPICAL CONSTRUCTION

BULLETIN NO. 74—15 AVAILABLE UPON REQUEST.

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CORE BORINGS
for
Foundations, Dams,
Bridges and all
Heavy Structures
GROUT HOLES

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Grafton, W. Va.

Literature Available

AERIAL SURVEY—A detailed explanation of aerial survey may be found in a booklet entitled, "Focusing on Facts." Detailed photographs and corresponding text show the many uses of photomaps in such fields as forestry, geology, and highway and city planning. The methods employed in the construction of photomaps, such as the mosaic and the slotted template, are thoroughly discussed. Also available is a Quick Reference Guide to the company's mapping products, which lists on one page the maps, methods of construction, and finally, a portion of the completed map. **Fairchild Aerial Surveys, Inc., CE-12, 224 E. Eleventh St., Los Angeles 15, Calif.**

INSTRUMENTS—Included in the booklet "Surveying, Mathematical and Drafting Instruments," are all models together with their technical features, specifications, and prices. **Filotecnica Salmoiraghi, Inc. CE-12, 41-14 24 Street, Long Island City 1, N. Y.**

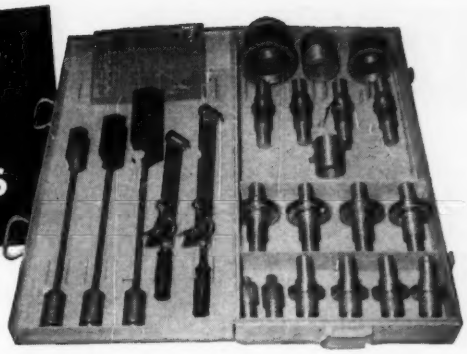
PIPE PILES—Some of the reasons for the use of lightweight pipe piles are enumerated in the illustrated catalog, No. 6401. Being straight and round, they can be handled and driven easier. Lapseam, spiral-weld construction provides 12% greater collapse strength than seamless pipe. Its full range of sizes permits selecting the wall thickness best suited for each job. Also included in the booklet are specifications for standard sizes and a typical driving log showing fast work progress. **L. B. Foster, CE-12, Pittsburgh 30, Penna.**

INSTRUMENTS—The latest catalog, No. 50, provides a complete list of Gurley engineering and surveying equipment such as transits, plane tables, water level recorders, tripods, and plummets. Distinct illustrations, specifications, principal parts, and prices of each instrument are included. **W. and L. E. Gurley, CE-12, Troy, New York.**

THEODOLITES—A complete discussion of the DK Double Circle Theodolites can be found in a new bulletin. The main features of the instrument are speed and ease of operation and a good deal of precision. The reading can be taken at a glance and each one automatically gives the arithmetic mean of two readings at opposite circle points. Large illustrations and specifications are included. A shorter

(Continued on page 126)

"IN-PLACE" SHEAR READINGS



FAST, ACCURATE, WITH NEW ACKER VANE TEST KIT!

The Acker Vane Shear Test Kit has everything needed to obtain fast, accurate, "in-place" shear readings to depths of 100 feet!

It's easy to use and provides accurate soils information at low cost! For ease in carrying, the entire set of tools are packaged in a handy steel kit.

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Assemble the Vane to the Rod!

Insert in Casing and Apply Pressure to the Torque Wrench!

Consult the Torque Chart for Accurate Reading!

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a complete line of Soil Sampling Tools, Diamond and Shot Core Drills, Drilling Accessories and Equipment

VULCAN

DGH-100 Portable Differential-Acting PILE HAMMER

Put this versatile DGH-100 Hammer to work on any job you have ★ you'll be amazed at the number of jobs it can handle ★ operates on compressed air or steam ★ delivers a rated striking energy of 386 pounds ★ just over 4 feet long it is readily moved about in a jeep. Illustrated here is the DGH-100 Hammer being used with a LeRoi Tract-Air breaking concrete curbing.

Manufacturers of Pile Driving Hammers and Piling Extractors Since 1852

VULCAN IRON WORKS INC. 327 North Bell Avenue, Chicago, U.S.A.

Literature Available

pamphlet, which offers a general idea and short description of the main characteristics of the most important instruments, is also available. **Kern Instruments, Inc., CE-12, 120 Grand St., White Plains, N. Y.**

MICRO-MASTER 105MM—Two brochures covering the new Micro-Master 105 mm are being offered. They point out that this process gives utmost protection and space economy in handling and filing drawings, documents, and records and greater accuracy by eliminating distortion. Negatives can be blown up to any size from card prints to 36-x54-in. Undesirable, dirty, creased, torn or smudged background is usually eliminated by photography. Its size permits "ganging up" —as many as eight 8½-x11-in. drawings can be made on a single negative. Another pamphlet entitled "The Pendulum Does It" discusses the new application of the pendulum to such devices as optical plumb bobs, self-indexing alidades, and self-leveling levels. **Keuffel and Esser, CE-12, 127 Fulton St., New York 7, New York.**

LAYNE PUMPS—The fact that a vertical turbine deep well pump and water well may be used as an instrument and a source of water to fight fires has been disclosed in a newly published pamphlet. Also it is now recognized that private property may be so protected by its own private system. It may be in the form of sprinkler protection—with or without elevated tank, depending on the demands of the local rating organization —or a yard hydrant system, the source of water being a water well pumped by a vertical turbine pump. Pressure is no longer a problem with this new method, for as long as water is available, it can be delivered at any desired pressure. Five distinct advantages of the vertical turbine deep well pump are listed and pictures are included. **Layne and Bowler, Inc., CE-12, Memphis 8, Tenn.**

CONCRETE PRESSURE PIPE—A fully illustrated booklet has been released on concrete pressure pipe for water supply, transmission, circulating systems, and sewer outfalls. It states that the pipe is extremely durable, reasonably priced, and reinforced. Its flexibility of design makes it readily adaptable to any pressure requirements commonly encountered in water works practice. Because the continuously smooth inner surface is made of concrete, it is immune to tuberculation. **Lock Joint Pipe Co., CE-12, P.O. Box 269, East Orange, New Jersey.**

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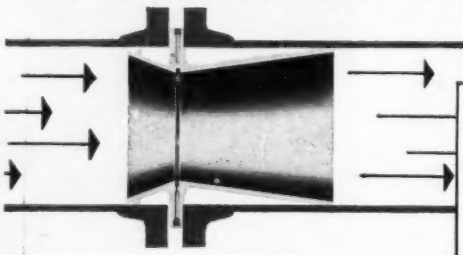
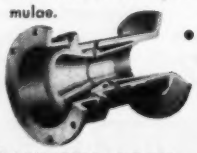


Get low cost flow metering with **Builders Dall Flow Tubes** — the primary element with the lowest pressure loss of any velocity-increasing differential producer!

- Greater instrument accuracy through higher differentials at the lowest total head loss.
- Fabricated design allows wide construction material choice to meet exact process specifications.
- All critical surfaces precisely machined to Dall formulae.
- *Enduring accuracy* through self-scouring, durable construction.



CAST DALL FLOW TUBE RECOMMENDED FOR WATER WORKS AND SEWAGE INSTALLATIONS

***Here's How!**

Builders Dall Tube #12D in 12" pipeline — max. differential 80" — max. flow 3900 GPM.	Pressure loss at max. flow— 2" of water
Orifice plate in 12" pipeline for same max. differential and flow	Pressure loss at max. flow— 31" of water
	Pressure loss saving with Dall Flow Tube — 93.5%

(On one installation, this saving produced pumping power cost reduction of $560.00 each year.)

Request Bulletin 115-DM1, from **Builders-Providence, Inc., 360 Harris Avenue, Providence 1, R. I.**

BUILDERS-PROVIDENCE
DIVISION OF
B-I-F INDUSTRIES
METERS FEEDERS CONTROLS

Literature Available

DRI-POR SYSTEMS—Four reprints of articles and one of an ad are available on the Dri-Por System of pile repair. Each one contains a description and photographs of the portable caissons, or K-boxes, in action on different jobs such as the James River Bridge System and the B and O swing-bridge pier. They all stress the fact that the K-boxes are designed for quick assembly and are dewatered by sump pumps. A gasket at the bottom is drawn tight to seal off seepage. Space within the box is ample for two workmen to set up steel forms. **Masonry Resurfacing and Construction Co., Inc., CE-12, Baltimore 26, Maryland.**

CONCRETE CONTROL—"Pozzolith Concrete Control Facts," a newly released bulletin, offers a complete picture of the use of Pozzolith in improving control of concrete properties such as strength, volume change, and permeability. **The Master Builders Company, CE-12, Cleveland 3, Ohio.**

POOL EQUIPMENT—A complete line of swimming pool equipment is displayed in the new 24-page bulletin. Everything from chemicals to lifeguard chairs is fully described with its price quoted. **National Pool Equipment Co., CE-12, Lee Highway, Florence, Alabama.**

PCA—A pamphlet has been published which describes the work of the Portland Cement Association. It states that the PCA is a national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work. It is non-profit, joined and supported voluntarily by some 70 member companies which produce a major proportion of the portland cement used in the United States. It has nothing to do with the production, distribution, pricing, or selling of the cement. It is a clearinghouse for the latest data on good concrete design practices and a source of up-to-the-minute information on new and improved construction. **Portland Cement Association, CE-12, 33 West Grand Avenue, Chicago 10, Ill.**

CYLINDER PILES—A new bulletin on prestressed cylinder piles has been published. Made of a series of sections placed end to end and held together by cables of high strength steel wire, the pile sections are manufactured by various processes, similar to the manner in which concrete pipe is commonly made.

(Continued on page 128)

Earle Units As Applied To Vertical Lift Bridges

Earle thrives on the big, tough assignments.

Heavy to medium machinery is our specialty. Try us!

THE TOUGH JOBS GO TO EARLE

- SPECIAL MECHANISMS
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"Gunite" is the modern process (sand and cement applied pneumatically) for repairing, constructing, lining:

- Reservoirs
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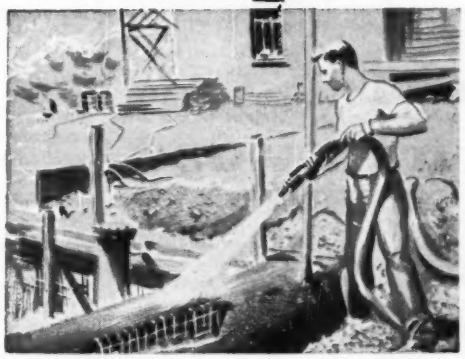

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THESE PHOTOS tell the story. Fir plywood reduces fins and joints to an absolute minimum . . . forms smoother, better looking concrete . . . cuts finishing time and costs. Fir plywood forms cut application time and costs, too. Interior PlyForm® grade gives up to 10-12 reuses; Exterior PlyForm® 25 or more; Overlaid plywood as many as 200!

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FREE: New portfolio to help you design and use fir plywood forms. Contains complete specification, construction and design data.

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Dept. 145, Tacoma 2, Wash.
Please send new Fir Plywood Concrete Form Portfolio. (Offer good USA only)

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Literature Available

Usually 16-ft long, each section is reinforced with a small amount of longitudinal and spiral steel to facilitate handling. Longitudinal holes for the prestressed wires are cored in the walls of the sections. Pictures of the different installations of prestressed concrete piles are placed throughout the booklet. **The Raymond Concrete Pile Co., CE-12, 140 Cedar St., New York 6, N. Y.**

CONCRETE COMPOUNDS—A 7-page booklet describing the different concrete and masonry compounds has been released. Included are materials such as Plastiment, Sikacrete, and Igas Joint sealer, together with their descriptions, advantages, and properties. **Sika Chemical Corporation, CE-12, Passaic, New Jersey.**

COMPRESSION TESTING—The first in a series of technical manuals on unconfined compression testing of cohesive soils has been made available. It is designed to meet the need of the engineer or laboratory technician for specific and authoritative information concerning testing equipment, laboratory and field testing procedures, and the interpretation and application of test results. **Soiltest Inc., CE-12, 4711 West North Avenue, Chicago 39, Ill.**

FIBER FORMS AND TUBES—Description, application, and technical data on Sonovoid fiber tubes and Sonotube fiber forms has been announced. Information on how to order and store these materials is included. **Sonoco Products Co., CE-12, Hartsville, S. C.**

HORIZONTAL SHORING—A new brochure issued for Spanall describes its horizontal shoring as consisting of two basic structural steel members, lattice and plate. They are assembled to desired span lengths simply by combining any one or more plate members with any one or more lattice members. **Spanall of the Americas, Inc., CE-12, 787 United Nations Plaza, New York, 17, N. Y.**

FOUNDATION WORK—A new pamphlet concerning difficult foundation work is divided into 7 sections-steel piles, caissons, underpinning, sheeting shoring and bracing, specialty jobs, heavy construction, and technical books. Containing illustrations and specifications, the pages indicate the scope and variety of the construction and engineering work done by the firm. **Spencer, White and Prentis, CE-12, 10 East 40 St., New York 16, N. Y.**

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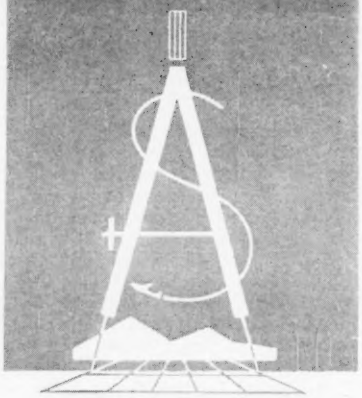

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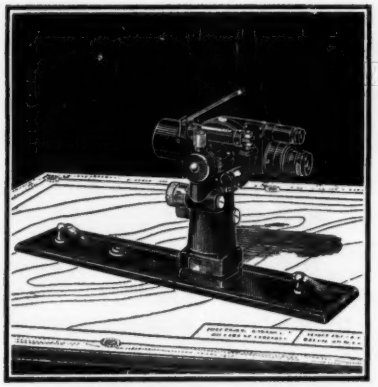

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Literature Available

SOIL SAMPLING EQUIPMENT—Some of the soil sampling equipment included in a new, 23-page booklet, are the Split Barrel, "Maine," and the "Shelby Tube." Each type is fully described, together with its dimensions and numbered diagrams. **Sprague and Henwood, Inc., CE-12, Scranton 2, Penna.**

CONCRETE FORMING EQUIPMENT—Two fully illustrated booklets concerning concrete forming equipment are now available .Products which are discussed include wood-ply and steel-ply forms, form ties, and safety shores. Detailed drawings and specifications are also contained in the pamphlet. **Symons Clamp and Manufacturing Co., CE-12, 4249 Diversey Ave., Chicago 39, Ill.**

UNI-FORM PANELS—Advantages of Uni-Form Panels are cited in a new brochure just released. They are completely assembled forms, modular in design, and of the best exterior plywood face. Having only three basic elements, panel, tie, and tie key, they can be assembled in three simple operations. The pamphlet is fully illustrated with clear-cut photographs. **Universal Form Clamp Co., CE-12, 1238 North Kostner Ave., Chicago 51, Ill.**

WATERSTOPS—Most rubber or copper waterstops have serious drawbacks as some of them require splitting the wooden form and bracing it so that the waterstop can protrude from one pour into the area where the next pour will come, thus involving costly carpentry. Others have folding fins which must be bent out into place after the first form is removed and the fins may be knocked out of position by the concrete pouring. The new waterstops, however, fit entirely inside the form for the first pour. Quickly nailed in place, no split form or other expensive carpentry is needed. More information may be obtained from a booklet called, "Labyrinth Waterstop." **Water Seals, Inc., CE-12, Chicago, Ill.**

SURVEYING INSTRUMENTS—Some of the principles which brought about revolutionary changes in the construction of geodetic instruments are discussed in a 26-page booklet. Large, clear-cut pictures, diagrams, and specifications are included. No attempt has been made to describe each instrument in detail. The directions of use, accuracy and field of application can be obtained upon request in separate descriptions for each instrument. **Wild Heerbrugg Instruments, Inc., CE-12, Main at Covert St., Port Washington, N. Y.**

Waterstop *in place in seconds!*

LABYRINTH WATERSTOP after first pour has been made and form removed. The grooves receive the concrete from the second pour, providing an interlocking joint.

Just a few seconds were needed to nail this LABYRINTH WATERSTOP to the form... just a few seconds and water seepage worries were over before they could ever have a chance to start.

LABYRINTH WATERSTOP forms a waterproof bond between two pours. The corrugated ribs bond firmly with the concrete.

LABYRINTH WATERSTOPS are made of flexible polyvinyl plastic... that has superior weathering qualities, is not affected by temperature changes and chemical activity.

LABYRINTH WATERSTOPS are easy to work with, can be cut to any desired length. "L" and "T" joints can be welded with just a hot knife. Find out now how your costs can be cut... and end your seepage problems. Just mail the coupon to:

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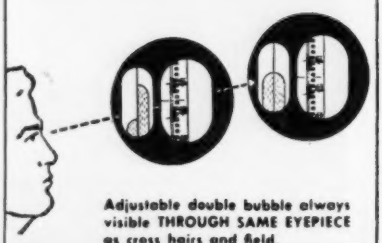

Adjustable double bubble always visible THROUGH SAME EYEPIECE as cross hairs and field.

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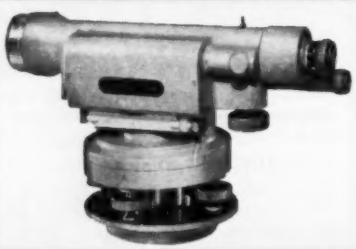

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RELOCATION: Simplex Forms System, Inc., manufacturers and distributors of forms for concrete construction of basements, walls, and swimming pools, has moved from 2500 North Main St., to a new enlarged plant, 5605 Industrial Ave., Rockford (Loves Park), Ill. . . . **EASTERN OFFICE:** Soiltest, Inc. has opened a new eastern office at 60 E. 42 St., New York 17, N. Y. . . . **NEW SERVICE:** Believing strongly in the concept that every conveyor system is different, depending on the job requirement, a new customer engineering division has been established by Fairfield Engineering Co. of Marion, Ohio . . . **EXPANSION PROGRAM:** In an expansion program designed to increase productive capacity, the S. Morgan Smith Co. has moved all valve operations from their R-S Plant in Phila. to the main one in York, Penna., where their Rotovalves, Ball Valves and large size butterfly valves are manufactured . . . **BELT STILL SERVICEABLE:** A transmission belt that has driven a crusher for 18 years without a lost-time failure while more than 5 million tons of rock have been crushed is still in excellent condition at The Melvin Stone Co., Melvin, Ohio . . . **NEW ACQUISITIONS:** Majority control of the Richmond Screw Anchor Co., the country's oldest and largest manufacturers of concrete form tying and anchoring devices, has been acquired by The Shattuck Denn Mining Corp. . . . Fuller Co. has directly entered the field of dust collection and recovery by the purchase of Dracco Corp. of Cleveland, Ohio . . . The floating dredge business of Bucyrus-Erie Co. has been acquired by Ellicott Machine Corp. . . . **DANGERS ELIMINATED:** The dangers connected with window washing have been removed from the new Morton Salt Co. office building by erecting reversible stainless steel windows that permit cleaning of both sides from inside the building . . . **NEW PLANTS:** The most powerful hydraulic turbines ever made in the United States will be built for the Lewiston Power Plant of the Niagara Power Project, now under development by the Power Authority of the State of New York. Rated at 200,000-hp each—when operated, for best efficiency, under a 300-ft head—they will have a capability of developing more than 240,000-hp under an effective head of 315-ft . . . Republic Steel Corp. will construct a new plant at Hammond, Indiana, for production of riveted corrugated metal drainage products . . . **APPOINTMENTS:** Robert H. Diller has been promoted to the position of Advertising Manager of Austin-Western Div., Baldwin-Lima-Hamilton Corp., it has been announced . . . A. L. Munsell has been named Assistant General Manager of Sales of Republic Steel Corp.

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October

1409. Anaerobic Reduction of Manganese in Reservoirs by John H. Weideman and Robert H. Fetner. (SA) Manganese may appear seasonally in some impoundments when part of the impoundment is anaerobic. One possible source of this manganese may be reduction of insoluble manganese dioxide found in the soil by carbon dioxide produced as an anaerobic by-product of biological metabolism.

1410. Niagara River Pollution, by Raymond W. Hess. (SA) The tremendous industrial development along the Niagara River created a pollution problem that has increased with time. Considerable study has been made into the pollutional problem and its solution. Progress is definitely being made to keep pollution to a minimum.

1411. Liquid Content of Garbage and Refuse, by John S. Wiley. (SA) The optimum moisture (water) content for aerobic composting of organic wastes varies considerably with the type of wastes. Determination of liquid content by a formula is proposed as an analysis more universally appliable than moisture content.

1412. Graphical Solution of Equations of Vibrations, by Wen-Hsiung Li. (EM) A graphical method is presented for analysis of dynamical systems of oscillations described by two simultaneous first-order ordinary differential equations. Examples of application are taken from hydraulic vibrations, including analysis of a differential surge-tank, and of a conduit with two surge-tanks.

1413. The Strength of Very Slender Beams, by E. F. Masur. (EM) The response of slender beams to lateral bending and torsion is analyzed. Large deformations lead to a nonlinear theory, whose strength predictions may deviate greatly from those of conventional linear analysis, especially with regard to rebundant bending moments in the major plane of the beam. The theory is corroborated experimentally.

1414. Coexistence of Fish and Dams, by Howard A. Preston and Louis E. Rydell. (PO) This paper outlines the background of the Columbia River salmonoid fishery, the problems of sustaining it in the face of intensifying watershed development, and the need of continued progress toward improvement of the fishery in the light of the program for river development.

1415. Discussion of Proceedings Papers 1073, 1141, 1196. (EM) William Prager closure to 1073. Anatol Roshko on 1141. I. K. Silverman on 1196.

1416. Discussion of Proceedings Papers 948, 1086, 1216, 1285, 1344. (PO) R. T. Richards, E. T. Keck, J. Junget closure to 948. C. P. Lindner, L. F. Johnson closure to 1086. Benjamin Donsky on 1216. Richmond Pearson Hobson, Fritz Heidinger on 1285. Sylvester V. Williams, Fritz Heidinger on 1344.

1417. Discussion of Proceedings Papers 1077, 1114, 1197, 1198, 1199, 1200, 1201, 1202, 1260, 1266, 1277. (HY) Harald Tults closure to 1077. Francis F. Escoffier closure to 1114. Thomas Maddock, Jr. on 1197. E. F. Rice on 1198. T. E. Stelson on 1199. Leo R. Beard, Manuel A. Benson on 1200. Leslie J. Hooper, B. L. VanderBoegh on 1201. E. M. Laursen and A. Toch on 1202. A. Rylands Thomas on 1260. E. A. Elevatorski on 1266. Lloyd C. Fowler and Robert H. Livesey on 1277.

1418. Inelastic Analysis of Eccentrically Loaded Columns, by M. E. Clark, O. M. Sidebottom, and R. W. Shreeves. (EM) This paper presents a theory by which the collapse load of an eccentrically loaded column can be rationally determined. Experimental verification of the theory was obtained from tests made on aluminum alloy rectangular and T-section columns. A study of the effect of time on the magnitude of the collapse load was also made, using SAE 1020 steel columns.

1419. Sir Adam Beck-Niagara Generating Station No. 2, by Frank Dobson. (PO) This paper presents design and construction features of an extension to a hydroelectric power generating station on the Niagara River and its associated works, with particular emphasis on the pump-storage-generating plan used to preserve the scenic spectacle of Niagara Falls.

1420. Fixed-Wheel Gates for Penstock Intakes, by Sylvan J. Skinner. (PO) There is a dearth of published information on actual overall design of high-head flat structural steel fixed-wheel gates used for emergency closure of penstock or other conduit intakes. This paper covers the major design problems and present design treatment by the Bureau of Reclamation, U. S. Department of the Interior, for this type of gate.

1421. The Regulation Chart for Power Computations, by C. P. Lindner. (PO) A rapid method is explained for computing power output and prime flow of a system of reservoirs and power plants. Adjustment of power output and prime flow for leakage and evaporation losses is described, and formulas for economic installation for secondary power are given.

1422. Discussion of Proceedings Papers 928, 1083, 1224. (SA) K. Fraschina on 928. D. E. Bloodgood, W. J. Boegly, and C. E. Smith closure to 1083. Harold E. Babbitt on 1224.

1423. Settling Behavior of Waste Suspensions, by Vaughn C. Behn. (SA) The qualitative mechanism of a settling slurry is set forth with consideration given to experimental equipment used to observe such behavior. The means by which data from such equipment has been analyzed quantitatively is delineated. The application to a sewage sludge is demonstrated.

1424. The Pressure Line and the Inelastic Buckling of Columns, by Frank Baron and Harold S. Davis. (EM) The pressure line concept developed for the elastic behavior of frames is extended to studies of the inelastic behavior of such structures and of eccentrically and laterally loaded columns.

1425. Redevelopment of Providence, Rhode Island, by Donald M. Graham. (CP) With federal assistance, the Providence Redevelopment Agency has effectuated a slum clearance project for a neighborhood, a small industrial redevelopment project, a large industrial redevelopment project, a neighborhood renewal project, and is presently improving community facilities that will serve the entire city.

November

1426. Chemical Grouting: Progress Report of the Task Committee on Chemical Grouting of the Committee on Grouting of the Soil Mechanics and Foundations Division. (SM) This report is divided into the following sections: injection processes, injection procedures, summary of field applications, patent abstracts, and annotated bibliography; describing all

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chemical processes known to the committee. The chemical composition of all grouts are given, where available, and where possible, the reaction involved with each grout.

1427. Thixotropic Characteristics of Compacted Clays, by H. B. Seed and C. K. Chan. (SM) Previous investigations of thixotropic effects in saturated clays are summarized, and thixotropic effects in compacted clays and their variation with soil composition is demonstrated. Test data is presented and effects of thixotropy on results of tests are examined.

1428. Laterite Soils and Their Engineering Characteristics, by K. S. Bawa. (SM) This paper gives a review of existing literature concerning the origin, distribution, and physical properties of laterite soils, and includes an evaluation from a civil engineering point of view.

1429. Geologic Investigations of Dam Sites by the SCS, by Gunnar M. Brune. (SM) The role of geologists in the Soil Conservation Service, particularly in connection with its dam building program, is examined. Types of drilling equipment used, organization of parties, and costs of drilling are dealt with. Geologic reports and laboratory analyses are also examined.

1430. Discussion of Proceedings Papers 941, 1079, 1081, 1159, 1160, 1161, 1204, 1205, 1299, 1309. (SM) No closure notice to 941. C. I. Mansur and R. I. Kaufman closure to 1079. Bramlette McClelland and John A. Focht, Jr. closure to 1081. J. F. Redus closure to 1159. Robert L. McNeill and Raymond Lundgren on 1160. Yoshichika Nishida on 1161. Judson P. Elston, Glebe A. Kravetz on 1204. J. D. Hodgson, C. Y. Li on 1205. W. Watters Pagon on 1299. H. Y. Fang on 1309.

1431. Torsion Analysis for Suspension Bridges, by Nan sze Sih. (ST) Equations are derived in this paper to determine stresses in stiffening trusses due to torsion, considering cable interaction and the effect of warping. Equations derived may also be used to determine certain constants for analysis of dynamic loads.

1432. A Simplified Design of Composite Bridge Stringers, by Jack C. Hacker. (ST) Equations for an approximate direct design of balanced composite steel stringers for ordinary highway bridges are presented in this paper. Numerical examples for the three basic types of steel stringers are worked out.

1433. Wood Diaphragms: Progress Report of a Sub-Committee of the Committee on Timber Structures of the Structural Division. (ST) Reduction of exterior structural walls by modern fenestration and omission of fixed partitions necessitates accurate engineering design to provide requisite strength and stiffness of wood-framed buildings, especially for lateral loads. This report is a digest of current technical information and a bibliography of sources regarding the engineering properties of wood-sheathed diaphragms.

1434. The Design of Rigid Frame Bents, by Richard Z. Zimmermann, Jr. (ST) This paper, demonstrating contemporary design procedures for indeterminate structures, is a comparison of three methods of solution available to the structural designer for determination of bending moments and shears in an unsymmetrical rigid frame bent subjected to a concentrated vertical load.

1435. Grit and Shot-Reinforced High Tensile Bolted Joints, by R. L. Sanks and C. C. Rampton, Jr. (ST) This paper considers the effect of paint in high tensile bolted joints and of grit and shot placed between painted contact surfaces. It is demonstrated that shot-reinforced painted joints are, in static tests, equal to or somewhat better than clean mill-scale joints and much superior to riveted joints.

1436. Deas Island Tunnel, by Per Hall, Troels Brondum-Nielsen, and H. R. Kivisild. (ST) The Deas Island Tunnel, under the Lower Fraser River at Vancouver, introduces to this continent the use of a trench type reinforced concrete four-lane traffic tunnel of rectangular cross section supported on sandfill jetted in place. Engineering and structural design of the tunnel, and approach structures are described.

1437. Analysis of Helical Beams under Symmetrical Loading, by Alan M. C. Holmes. (ST) Thorough analysis of moments and deflections of a helical beam is simplified by consideration of the symmetrical case, and relationship between design variables and behavior of structure is shown. Tables and curves are presented for members of rectangular section, showing the greater structural efficiency and smaller deflection of shallower members.

1438. Garrison Dam—Tunnel Test Section Investigation, by Harris H. Burke. (SM) These two papers describe an extensive six-year investigation of tunnel loading in a large (36-ft diameter) tunnel test section at Garrison Dam, including application of results to the eight prototype tunnels, and observations on their initial performance.

1439. Garrison Dam—Evaluation of Results from Tunnel Tests Section, by K. S. Lane. (SM) This paper describes the principal methods employed in evaluating the observations from the large tunnel test section, and major results. New analytical methods are presented, and their possible application is examined.

1440. Effect of Initial Eccentricities on Column Performance and Capacity, by John M. Hayes. (ST) This paper summarizes results of tests made on the effect of initial eccentricities on column performance and capacity. The rolled H-section of ASTM A7 structural steel was investigated.

1441. Elastic Structures with Nonlinear Load-Deflection Curves, by Benjamin M. Ma. (ST) This paper presents the essential characteristics of the action of a simple structure in practical use for which the linear stress-strain relation results in a nonlinear load-deflection curve, involving a region where the load decreases with increase in deflection.

1442. Discussion of Proceedings Papers 1106, 1189, 1233, 1234, 1254, 1255, 1303, 1316, 1318. (ST) Robert M. Barnoff closure to 1106. Anthony M. DiGioia on 1189. John E. Goldberg, Kenneth H. Lenzen, R. A. Williamson, Zdenek Sobotka, E. Neil W. Lane on 1233. DeForest A. Matteson, Jr. on 1254. Masso Naruoka, Benjamin C. F. Wei on 1255. Masso Naruoka on 1303. T. Au on 1316. Masso Naruoka on 1318.

1443. Electric Analog for Level-Net Adjustment, by Hsuan-Loh Su. (SU) A method is suggested, using the analogy between the electrical network and the level net, for adjustment of a level net. Calculation methods are simple, and results are automatically checked.

1444. Electronic Computers in Surveying Operations, by Arthur J. McNair. (SU) Examples of computing both routine and more elaborate problems by use of electronic digital computers in surveying operations are given. Opportunities for new concepts in the teaching of surveying by use of an electronic computer are described.

1445. Distance Measurement with the Geodimeter and Tellurometer, by John S. McCall. (SU) The practical uses of the measurement of distances by electronic means are presented in this paper. Some of the applications would include rapid measurement of lines of a triangulation net, traverse in rough country or over bodies of water, and coastal hydrograph surveys.

1446. Surveying and Mapping, St. Lawrence Power Project, by John D. Officer. (SU) The agencies developing the St. Lawrence Power Project solved many surveying and mapping problems while obtaining detailed topographic and property maps, and establishing horizontal and vertical control for structures. Each agency had a different method of accomplishing the same coordinated results.

1447. A Meteorological Method for Profile Surveying, by L. V. Toralballa. (SU) This paper derives a hydrodynamic equation similar to that which underlies the method generally known as Airborne Profile Recording, but one that is free from the assumption that the wind is geostrophic. An aircraft is made to fly along an isobar and certain atmospheric measurements are taken enroute, as well as at the ends of the trajectory and on the two ground points.

1448. Discussion of Proceedings Paper 1064. (SU) E. D. Morse closure to 1064.

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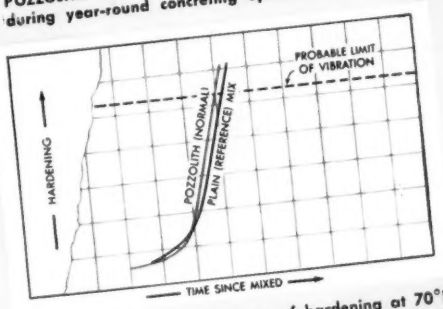
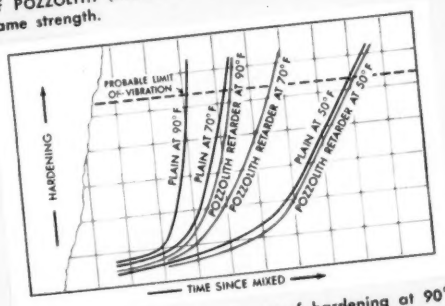


CHART 1 — Comparison of rate of hardening at 70°F. of POZZOLITH (Normal) and Plain mixes designed to same strength.



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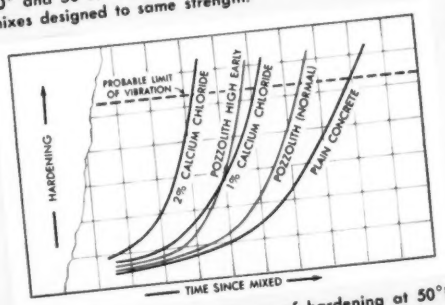

CHART 3 — Comparison of rate of hardening at 50°F. of POZZOLITH High Early and POZZOLITH (Normal) mixes, with Plain and Calcium Chloride mixes of equal cement content.

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In addition to reducing water content approximately 20% with attendant benefits, POZZOLITH provides desired handling, placing and finishing time under widely varying job conditions. Whether normal, retarded or accelerated hardening is required, good uniform concrete is obtained with POZZOLITH.

Limit of vibration referred to in these charts is the point during hardening of concrete when it no longer can be reworked or be made plastic by the use of vibrators.

CHART 1 — Normal Hardening

POZZOLITH (Normal) mix has practically the same rate of hardening as the Plain mix of equal strength.

CHART 2 — Retarded Hardening

At 90°, the POZZOLITH Retarder mix has a rate of hardening similar to a Plain mix at 70°. Controlled retardation aids in overcoming difficulties in mixing, handling, placing and finishing concrete at high temperatures. Its benefits include:

1. *Greater flexibility in the scheduling of finishing operations for large areas.*
2. *Overcoming stiffening enroute where concrete is transported long distances.*
3. *Reduced cracking of concrete slabs and paving from premature stiffening of surface.*
4. *Avoiding cold joints between subsequent pours in mass or structural concrete.*

At 70°: POZZOLITH Retarder provides advantages similar to those listed above.

At 50°: POZZOLITH Retarder is unique in that it does not retard more than Plain mixes at the same low temperatures. This safeguards against excessive retardation from an unexpected drop in temperature.

CHART 3 — Accelerated Hardening

At low temperatures and with equal cement factors, POZZOLITH (Normal) mixes harden sooner than Plain mixes. POZZOLITH High Early mixes harden more rapidly than 1% Calcium Chloride mixes. Both POZZOLITH formulations facilitate earlier finishing.

Page from booklet "POZZOLITH® Concrete Control Facts" . . .

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